UNIVERSITY OF TORONTO

CALENDAR

Faculty of Applied Science
and Engineering

1960-1961

UNIVERSITY OF TORONTO PRESS
1960

CALENDAR 1960

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CALENDAR 1961

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CONTENTS

SECTION 1. CALENDAR 1960–61

FALL TERM, 1960

July 1	*Friday*	Dominion Day. Buildings closed.
July 8	*Friday*	Last day for receiving applications for supplemental examinations.
August 1	*Monday*	Civic Holiday. Buildings closed.
August 8	*Monday*	Supplemental Examinations commence.
August 15	*Monday*	Students of the III Year, Course 1, report at Survey Camp.
August 22	*Monday*	Students of the III Year, Courses 2 and 9, report at Survey Camp.
September 1	*Thursday*	Last day for receiving applications for admission to the I Year.
September 5	*Monday*	Labour Day. Buildings closed.
September 6	*Tuesday*	Students in IV Year, Course 1, Group B, report at Survey Camp.
September 7	*Wednesday*	Students in II Year, Course 6, report for Analytical Chemistry Laboratory.
September 8	*Thursday*	Special Meeting of Faculty Council.
September 15 September 16	*Thursday* *Friday*	Registration in person of the I Year from 9.30 a.m. to 12 noon and from 2.00 p.m. to 4.30 p.m. at 119 St. George Street.
September 19	*Monday*	Registration in person of the II and III Years from 9.30 a.m. to 12 noon, and from 2.00 p.m. to 4.30 p.m. at the Mining Building.
		Dean's address to the I Year.
		Preliminary instruction to the I Year.
September 20	*Tuesday*	Registration in person of the IV Year from 9.30 a.m. to 12 noon, and 2.00 p.m. to 4.30 p.m. at the Mining Building.
		Meeting of the Faculty Council.
September 21	*Wednesday*	Lectures and Laboratory work commence at 9.00 a.m.
		The opening address by the President to the students of all Faculties at 3:45 p.m. in Convocation Hall.
October 5	*Wednesday*	Meeting of Faculty Council.
October 10	*Monday*	Thanksgiving Day. Buildings closed.
October 14	*Friday*	Meeting of Senate.

November 1	*Tuesday*	Meeting of Faculty Council.
November 11	*Friday*	Remembrance Day Service 10.45 a.m. Lectures and laboratory classes withdrawn from 10 a.m. to 12 noon.
		Meeting of Senate.
November 25	*Friday*	Fall Convocation.
December 1	*Thursday*	Meeting of Faculty Council.
December 9	*Friday*	Meeting of Senate.
December 16	*Friday*	Term ends at 5.00 p.m.
December 19	*Monday*	First Year Term Examinations.
December 20	*Tuesday*	First Year Term Examinations.
December 25	*Sunday*	Christmas Day.

SPRING TERM 1961

January 1	*Sunday*	New Year's Day.
January 3	*Tuesday*	Mid-session Examinations.
January 4	*Wednesday*	Mid-session Examinations.
January 5	*Thursday*	Lectures and Laboratory work for all years and all courses begin at 9.00 a.m.
January 10	*Tuesday*	Meeting of Faculty Council.
January 13	*Friday*	Meeting of Senate.
January 16	*Monday*	Last day for receiving the second term instalment of fees.
January 19	*Thursday*	IV Year Employment interviews.
January 20	*Friday*	IV Year Employment interviews.
January 21	*Saturday*	IV Year Employment interviews.
February 3	*Friday*	Meeting of Faculty Council.
February 10	*Friday*	Meeting of Senate.
March 1	*Wednesday*	Meeting of Faculty Council.
March 10	*Friday*	Meeting of Senate.
March 31	*Friday*	Good Friday. Buildings closed.
April 1	*Saturday*	Buildings closed.
April 3	*Monday*	Meeting of Faculty Council.
April 7	*Friday*	Term ends at 5.00 p.m.
April 14	*Friday*	Meeting of Senate.
April 17	*Monday*	Annual Examinations commence.
May 3	*Wednesday*	Meeting of Faculty Council.
May 12	*Friday*	Meeting of Senate.
May 22	*Monday*	Victoria Day. Buildings closed.
May 30	*Tuesday*	University Commencement.
May 31	*Wednesday*	University Commencement.
June 1	*Thursday*	University Commencement.
June 2	*Friday*	University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

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Registrar . . . . R. Ross, M.B.E., M.A.
Chief Librarian . . . . R. H. Blackburn, M.A., B.L.S., M.S.
Warden of Hart House . . . . J. McCulley, M.A.
Director of University Extension . . . D. C. Williams, M.A., PH.D.
Director of Information . . . . K. S. Edey
Director of Alumni Affairs . . . . J. C. Evans, B.A.

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Superintendent of Buildings and Grounds . . F. J. Hastie, B.SC., P.ENG.
Chief Accountant . . . . D. J. Reid

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Assistant Director of University Health Service—Women
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Director of Athletics and Physical Education—Men W. A. Stevens, B.S.
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Director of the University of Toronto Press . . . M. Jeanneret, B.A.
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E. A. Macdonald, B.A.
Associate Secretary of the Students' Administrative Council
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Director of Hart House Theatre . . . . R. S. Gill, M.A.
Director of the Placement Service . . J. K. Bradford, O.B.E., M.A.SC.

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Assistant Dean and Secretary . . . . W. S. Wilson, E.D., B.A.SC.
Assistant Secretary . . . . J. A. Gow, B.A.SC.
Student Counsellor . . . . W. J. T. Wright, M.B.E., B.A.SC., B.A.

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Professor Emeritus of Mining Engineering

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H. F. Davidson, B.A.SC. — 1025 Albertson Cres., Lorne Park
M. K. Strang, B.A.SC. — 82 Rykert Cres.

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J. H. Harrington, m.a.sc.	477 Rosewell Ave.
J. Rezek, m.a.sc.	198 Strathearn Rd.
A. Sreenivas, m.a.sc.	327 Huron St.
J. Cox, b.a.sc.	1675 Eglinton Ave. W.
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H. J. Meyer, b.a.sc.	247 Franklin Ave.
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S. Wilkening, b.a.sc.	394 Brunswick Ave.
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SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant-Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers, and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate, by statute subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909–1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910–1911. In the session 1923–24 the degree was changed to B. Arch. for the students graduating in Architecture. On July 1, 1948, the School of Architecture was separated from the Faculty and became an independent School with its own Director and Council.

With the end of the Second World War during the summer of 1945 the University was faced with the difficult problem of providing accom-

modation for almost double the number of students that had been registered in the previous year. Through the efforts of the Chairman of the Board of Governors and the President, the University leased from the Crown part of the large shell-filling plant at Ajax, twenty-five miles east of Toronto, to relieve the heavy demand for space at Queen's Park. Because it became evident, at an early stage, that a relatively large number of students would register in the Faculty of Applied Science and Engineering, it was decided that the work of the First and Second Years of this Faculty should be given at Ajax.

A special First Year session with approximately 1400 students commenced at Ajax on January 14, 1946. In the regular 1946–47 session both First and Second Year instruction, except Second Year in Architecture, was given at Ajax with 1800 registered in the First Year and 1500 in the Second Year. In the 1947–48 session the enrolment at Ajax consisted of 1200 students in the First Year and 1400 in the Second Year. In the session 1948–49, 600 were registered at Ajax in the First Year and 975 in the Second Year. All other instruction was given in Toronto.

To provide for this self-contained University community at Ajax, there were 446 acres and 111 buildings. The University operated such services as central heating, road maintenance, water supply, sewage disposal, fire department, transportation, post office, laundry, private hospital, cafeteria, tuck shop and barber shop. Former production-line buildings were altered to accommodate 37 lecture rooms, 20 draughting rooms and 14 laboratories. In the 1946–47 session, 2300 students were in residence, in 1947–48 there were 1800 students and in 1948–49 there were 900. Student life at Ajax compared favourably with that in Toronto, excellent accommodation being provided for a general circulating library, a technical library, Hart House Ajax, the Athletic Association, the Health Service, Students' Administrative Council, Advisory Bureau for Ex-Service Students, and a small chapel.

With the completion of the Wallberg Building and the extension of the Mechanical Building, additional accommodation became available on the Queen's Park Campus, and this fact coupled with the decrease in numbers entering each year brought about the closing of Ajax on May 31, 1949.

SECTION V. ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

RESTRICTION OF REGISTRATION

For the Session 1960–61 registration in the Faculty of Applied Science and Engineering will be limited in the First Year to approximately 725 students and the right is also reserved to limit the number of students admitted to any course in the Faculty. Students admitted to advanced standing in the Second Year will be limited to approximately 40, in the Third Year to approximately 20, and in the Fourth Year to approximately 60. These restrictions will remain in force until additional accommodation and facilites become available.

1. GENERAL ADMISSION REQUIREMENTS

A candidate for admission to the first year must present the Ontario Grade 13 certificate or an equivalent certificate showing standing in the following subjects, with an overall average of at least 64%.

English:	Literature Composition	
Mathematics:	Algebra Geometry Trigonometry	
Science:	Chemistry Physics	
One of:	French German Greek Italian Latin Spanish	*Authors and Composition*

A careful selection of the five subjects (nine papers) to be studied in the Grade 13 programme will allow the candidate to meet *both* the general and specific requirements.

SPECIFIC ADMISSION REQUIREMENTS

Applications for admission to the course in Engineering Physics, in addition to meeting the general requirements, must have an average of at least 75% in the four papers: Algebra, Geometry, Trigonometry and Physics. Those intending to pursue work in Aeronautical/Astronautical Engineering will register in Engineering Physics, in which course an option is offered in the Third and Fourth Years. For further information see page 61.

2. EQUIVALENT CERTIFICATES

The following certificates are usually accepted as equivalent to Ontario Grade 13. Standing in the following certificates is required as outlined in (1) above.

CANADA:

Alberta, Manitoba, Nova Scotia, Saskatchewan—Grade 12.
British Columbia, New Brunswick—Senior Matriculation.
Newfoundland—First Year Memorial University.
Prince Edward Island—Third Year Certificate of Prince of Wales College.
Quebec—Senior High School Leaving Certificate or McGill Senior School Certificate.

BRITISH COMMONWEALTH:

Passes in the General Certificate of Education, Advanced level in a mathematical subject and in either Physics or Chemistry; passes at the Ordinary level in English Language, English Literature, a language other than English, and in either Physics or Chemistry, whichever is not submitted at Advanced level.

UNITED STATES OF AMERICA:

A United States High School Graduation Diploma will not admit an applicant to this Faculty.
First Year College credits in the required subjects from accredited institutions will be accepted for admission, provided satisfactory standing is obtained and the approximate number of semester hours of credit obtained as indicated:

English (including an intensive course in Literature)	6
Algebra	3
Analytical Geometry	3
Plane Trigonometry	3
Physics	3
Chemistry	3
A language other than English	6

Applicants seeking admission on the basis of certificates not included in the above are advised to submit photostatic copies of their certificates to the Registrar of the University for evaluation. When these certificates are in a language other than English, notarized English translations must accompany the photostatic copies.

3. ADMISSION REGULATIONS RE CANDIDATES HAVING PREVIOUSLY FAILED

(a) Subject to other statutes and regulations of the University, any student who on two occasions fails to secure the right to advance to a higher year in University work shall be debarred from the University.

This regulation applies to students enrolled in all Divisions of the University *except* Law, the School of Social Work, the Professional Years in Medicine and the School of Graduate Studies.

(b) Subject to other statutes and regulations of the University, a student who withdraws after February 15th, or who does not withdraw but does not write the annual examinations, shall be regarded for purposes of debarment from the University as having failed his year. This regulation applies to students registered in any Division of the University *except* the Faculty of Law, the Professional Years in Medicine, the School of Social Work and the School of Graduate Studies.

4. ADMISSION REGULATIONS—MATURE STUDENTS

With effect from 1st July 1961, a candidate of mature age (30 years or older on October 1st of the Session to which admission is sought) who is normally resident in Ontario, may request special consideration if he or she has not completed in full the published Grade 13 (or equivalent) requirements.

Applicant must submit a birth certificate at the time of application.

5. ADMISSION REGULATIONS—PROBATIONARY STUDENTS

(a) Students admitted on probation by special action of the Committee on Admissions must obtain standing in their first year of full-time study. If they obtain standing the probationary status will be removed; if they do not obtain standing they will not be allowed to repeat the year or to enrol in any other course in the University of Toronto until they meet in full the published admission requirements.

(b) Probationary students admitted by special action of the Committee on Admissions on condition that they secure certain additional standing at the Ontario Grade 13 or an equivalent level, or in additional university subjects in the first year will not be permitted to continue in the University if the admission condition is not satisfied within one year from the date of first admission.

6. ENGLISH FACILITY REQUIREMENTS

All applicants are required to submit evidence acceptable to the University of Toronto of facility in English. Standing as outlined in one of the following will be regarded as acceptable evidence of English facility:

(a) Standing, in accordance with the General Admission Requirements, in English in the Ontario Grade 13 Certificate, or other certificates recognised by the University of Toronto as equivalent.

(b) The Certificate of Proficiency in English issued by the Universities of Cambridge or Michigan, or satisfactory achievement in the University of Michigan English Language Test. (Details regarding the foregoing may be secured from the registrar, University of Toronto.)

The University is prepared to consider other evidence of English facility which should be submitted for evaluation to the Registrar of the University.

7. APPLICATION PROCEDURES

Candidates for admission should apply to the Registrar of the University for admission application forms; they are required to complete such forms and return them to the Registrar at the earliest date possible, and in any event not later than September 1st. *Applications received after September 1st will be refused.*

(a) *Application for Admission to First Year*

Candidates seeking admission to first year must submit to the Registrar of the University:

(i) Completed application forms as outlined above.

(ii) Ontario Grade 13 or equivalent certificates indicating the subjects studied and the grades secured.

(iii) Such other information as may be required by the University.

(b) *Application for Admission with Advanced Standing*

Applicants seeking admission on an Advanced Standing basis must submit to the Registrar, prior to September 1st in the Session in which they wish to enrol:

(i) Completed application forms as outlined above.

(ii) Certificates giving detailed information as to subject and grades secured in the successful completion of Ontario Grade 13 or equivalent examinations.

(iii) Official transcript(s) issued by the universities previously attended, giving in detail the courses completed with the standing or grade in each. (Transcripts must indicate that the applicant concerned has been granted honourable dismissal, is in good standing and/or may return to the institution concerned.)

(iv) Official statement(s) or calendar(s) giving full information on the content of the university courses covered by the transcript(s) submitted.

8. REGISTRATION PROCEDURES AND REGULATIONS

(a) Every person admitted to the University as an undergraduate must, at the time of his or her first medical examination by the University Health Service, present satisfactory evidence of successful vaccination, or must be vaccinated by the examining physician.

(b) A student must comply with such other registration procedures as may be required by the University.

(c) A student who fails to register at the prescribed time will be required to pay an additional fee of $10.00 for late registration to the Chief Accountant.

(d) The Council of the division to which an applicant has been admitted may at its discretion refuse a student permission to register late.

9. PROCEDURE FOR TRANSFERS AND WITHDRAWALS

A student desiring to transfer to another division of the University or to withdraw from the University, must surrender his Admit-to-Lectures Card to the appropriate officer of the division concerned and must complete withdrawal forms as required by the University. In order that adjustment of fees may be made, notice of transfer or withdrawal must be completed without delay. In the case of a student who wishes to transfer to another division at the time of first admission to the University, it is required that such a student apply for an amended admission letter to the Registrar of the University.

SPECIAL STUDENTS

Graduates of the University of Toronto and of recognized universities who wish to take one or more undergraduate subjects may be registered as special students in the Faculty of Applied Science and Engineering, subject to the approval of the teaching department concerned. Application must be made to the Secretary of the Faculty.

RESIDENCE ACCOMMODATION

There is a University Men's Residence (Devonshire House) for which men undergraduates are eligible but which can accommodate only a small percentage of them. Early application is advisable. Apply to the Secretary, Men's Residences, Simcoe Hall.

Each of the four Arts Colleges also maintains a Men's Residence into which some engineering students are accepted. Further information may be obtained from:

University College—Dean of Men
Victoria College—Senior Tutor
Trinity College—Registrar, Trinity College
St. Michael's College—The Superior

The Housing Service in the Students' Administrative Council Building assists students in finding convenient lodgings.

CHILDREN OF WAR DEAD (EDUCATION ASSISTANCE) ACT

Children of War Dead (Education Assistance) Act provides fees and monthly allowances for children of veterans whose death was attributable to military service. Enquiries should be directed to the nearest District Office of the Department of Veterans Affairs.

SECTION VI. FEES, DEPOSITS AND EXPENSES

FEES

1. A student who desires to enrol in the Faculty of Applied Science and Engineering is required to pay at least the First Term Instalment of fees on or before the opening date of the session, and before he can receive his registration card from the Secretary of the Faculty. The amount of the First Term Instalment of fees or of the Total Fee for the session may be ascertained from the schedule of fees below.

2. The Second Term Instalment of fees, if not already paid, is payable on or before January 15th. After this date an additional fee of $3.00 per month or portion thereof (not exceeding $10.00), will be imposed until the whole amount is paid. All fees for the session must have been paid in full before the student can be admitted to the annual examinations.

3. In order to avoid delay in registration at the opening of the session it is recommended that at least the First Term Instalment of fees be forwarded by mail as early as possible in September, together with a form, in duplicate, to be provided by the Secretary of the Faculty and filled out by the student, giving his full name, course, year, etc.

4. University fees are payable at the Office of the Chief Accountant, Simcoe Hall, which will be open for the receipt of fees from 9 a.m. to 5 p.m. daily from September 5th to 20th (Saturday, September 17th, 9 a.m. to 12 noon), and from 9 a.m. to 1 p.m. daily except Saturday during the remainder of the session. Cheques in payment of these fees should be made payable to the University of Toronto at par in Toronto.

5. Each undergraduate enrolled in the Faculty of Applied Science and Engineering must pay annual fees to the Chief Accountant according to the schedule below; the total fee in each case is made up of the academic fee and incidental fees; all incidental fees are payable in the first term.

Schedule of Fees

Men

Academic Year	*Academic Fee	†Incidental Fees	Total Fee (if paid in one instalment)	First Term Instalment	Second Term Instalment
I-IV	$550	$54	$604	$329	$278

Women

I-IV	$550	$31	$581	$306	$278

*The Academic Fee includes the following fees:—
Tuition; Library and Laboratory Supply; one Annual Examination; Laboratory Fee; Physical Education; and Degree.

†These Incidental Fees include the following fees:—
For men—Hart House; Students' Administrative Council; Athletic; Health Service; Engineering Society; Faculty Athletic Association.
For women—Students' Administrative Council; Athletic; Health Service; Engineering Society.

6. A late registration fee of $10.00 will be assessed against any student who registers after the last date for normal registration in his or her faculty or school.

OTHER UNIVERSITY FEES

7. Each student is required to pay to the Chief Accountant at the opening of the session, or as otherwise specified, such of the following fees as may be required of him.

EQUIVALENT CERTIFICATE FEE

8. Each student who has been admitted to the First Year upon a certificate or certificates granted outside the Province of Ontario and covering all or any part of the admission requirements, must pay a fee of $5.00.

ADVANCED STANDING FEE

9. Each student who has been admitted to advanced standing from another university or college, must pay a fee of $10.00.

SPECIAL PHYSICAL EDUCATION FEE

10. Each student who has neglected to complete satisfactorily the course in Physical Education of the First Year, and who must take this work during the Second Year of his or her attendance must pay a fee of $50.00.

SUPPLEMENTAL EXAMINATION FEES

11. Each candidate for a supplemental examination is required to pay a fee to the Chief Accountant not later than August 9th. The fee is $10.00 for one subject and $5 for each additional subject, including laboratory supplementals. For each supplemental examination in a laboratory subject requiring special supervision, there is an additional fee of $10.00. The additional laboratory supplemental fee should not be paid until the candidate is notified by the Secretary.

SPECIAL STUDENTS FEES

12. The fee is $75.00 per subject, payable to the Chief Accountant.

SUMMARY OF STUDENTS' EXPENSES

13. The following approximate statement of expenses will give the student a general idea of the cost of obtaining an education in the Faculty of Applied Science and Engineering in the University of Toronto, exclusive of personal expenses:—

1. Fees, see schedule, page 25.
2. Board and Lodging, per week ....$20.00 up
3. Books and instruments, per year ....about $100

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating course in which he intends to proceed to a degree. There are nine courses in Engineering, from which the selection may be made, viz.,

Civil Engineering (Course 1),
Mining Engineering (Course 2),
Mechanical Engineering (Course 3),
Industrial Engineering (Course 4),
Engineering Physics (Course 5),
Chemical Engineering and Applied Chemistry (Course 6),
Electrical Engineering (Course 7),
Metallurgical Engineering (Course 8),
Applied Geology (Course 9),
Aeronautical/Astronautical Engineering (see page 61).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the above courses.

3. The courses extend over four academic years. A student must pass in the work of each academic year before proceeding to the work of the next. See Sec. IX.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 15.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction are given in Sec. VIII.

7. Examinations are conducted as explained in Sec. IX.

8. Students in Civil Engineering, Mining Engineering, Mechanical Engineering, Industrial Engineering, Chemical Engineering, Electrical Engineering, Metallurgical Engineering and Applied Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. (See Sec. VIII.)

GRADUATE STUDY AND RESEARCH

Facilities are available in the Departments of the Faculty, for graduates with good records of this University or of another University of comparable standing, for post-graduate study and research leading to

the degrees of Master of Applied Science (M.A.Sc.) and Doctor of Philosophy (Ph.D.). For further information see the Calendar of the School of Graduate Studies. In some cases financial support for equipment and salaries of research assistants may be obtained through the School of Engineering Research, an organization within the Faculty established by the late Dean Ellis in 1917.

Bursaries and Scholarships for graduate students are available in limited number as shown on page 131. Many part-time demonstratorships are open which permit post-graduate work towards a degree.

INTERIM HIGH SCHOOL ASSISTANT'S CERTIFICATE, TYPE A

Graduation in Engineering Physics is accepted by the Ontario College of Education as meeting the academic requirements for admission to the course leading to a Type A certificate in Mathematics and Physics.

Graduation in Civil Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering and Metallurgical Engineering with an average of 66% or more in the final year is accepted by the Ontario College of Education as meeting the academic requirements for admission to the course leading to a Type A Certificate in Applied Science.

ASSOCIATIONS OF PROFESSIONAL ENGINEERS

Graduation from the Faculty of Applied Science and Engineering leads to registration as a Professional Engineer in the various Associations of Professional Engineers throughout Canada.

SECTION VIII. CURRICULUM

The courses of instruction are designed to give the student a thorough grounding in the fundamentals of engineering, and, in addition, sufficient familiarity with the practical application of the principles to make him useful upon graduation. The courses are very similar in the First Year with the exception of Engineering Physics. In the succeeding years specialization develops to some extent with provision in the Third and Fourth years for optional subjects in some of the graduating courses.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As the future engineer is vitally concerned with the development of the country, it is essential that he be instructed in the rudiments of economics, administration, and business, which, with his scientific training, will enable him to increase his usefulness to the full.

Recognizing the growing emphasis of outstanding engineers and of the great professional organizations on the importance of breadth in engineering education, this Faculty liberalized its curricula, effective with the session 1944–45. The subjects that are considered to belong to the liberal system, involving about 6 per cent of the total time of four undergraduate years, are the following: English, Economics, Modern World History, Political Science and Philosophy of Science.

Care has been taken to co-ordinate the liberal studies of the curriculum in such a manner as to form an integrated whole. Each derives support from those that have gone before and is the better understood by reason of them.

While a knowledge of these subjects does not form a part of the technical equipment of the engineer, it does add markedly to his ability to function as a broadly educated and effective citizen and thereby advances the prestige of his profession and himself in the mind of the general public.

The student who thoughtfully attends to what is offered in this so-called humanistic-social programme and follows it by self-directed reading and reflection will without question add notably to his qualifications for ultimate professional leadership. He will be the better able to discharge the double obligation laid upon him—to perform his technical duties efficiently and honourably and equally to contribute to the political, social, and cultural welfare of the community and country in which he lives.

In some graduating courses, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances, the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful

training in methods of research. In this way the undergraduate course is linked with the graduate courses and with the work of the School of Engineering Research (page 27).

As part of the laboratory instruction, excursions to places of technical interest, both in Toronto and elsewhere, are arranged by the staff. These excursions are treated as laboratory periods with the same requirements as to attendance and reports.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The programme and regulations regarding the courses of study and examination, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course to the conditions here laid down.

Communications relating to curricula, instruction, and examinations in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information regarding the courses of study leading to the post-graduate degrees, Master of Applied Science, and Doctor of Philosophy, see the calendar of the School of Graduate Studies, which gives full particulars.

FIRST YEAR CURRICULUM

The courses in Mechanical Engineering. Industrial Engineering, Chemical Engineering, Electrical Engineering and Metallurgical Engineering, designated as Division A have a common First Year and the courses in Civil Engineering, Mining Engineering and Applied Geology have a common First Year differing from that of Division A only in that Surveying is included. The First Year curriculum in Engineering Physics is designated as Division C.

A student, on petition to the Council, may be permitted to change his course at the end of the First Year.

FIRST YEAR CURRICULUM

Division A		Division B
Mechanical Engineering		Civil Engineering
Industrial Engineering	and	Mining Engineering
Chemical Engineering		Applied Geology
Electrical Engineering		
Metallurgical Engineering		

First Year Subjects Divisions A & B	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	221, 222	2	3	2	3
Engineering Problems					
and Drawing..............	275	–	6	–	6
English.....................	610	1	–	1	–
Political Science..............	323	1	–	1	–
Mathematics:					
Analytical Geometry........	492, 275	1		1	
Calculus..................	490, 275	2	3	2	3
Descriptive Geometry.......	269	1		1	
Physics:					
Electricity	330	2		2	
Mechanics	20	2	3	2	3
Structure and Properties					
of Matter...............	676, 677	2		2	
Physical Education...........	640	–	2	–	2
Practical Experience..........	690	–	–	–	–
Surveying (Division B only)...	710, 712	1	3	–	–

Division C
Engineering Physics

First Year Subjects Division C	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry..................	223, 222	2	3	2	3
Engineering Problems					
and Drawing..............	276	–	6	–	6
English.....................	610	1	–	1	–
Political Science..............	323	1	–	1	–
Mathematics:					
Algebra and Geometry......	502, 276	2	–	2	–
Calculus..................	503, 276	2	–	2	–
Descriptive Geometry.......	269	1	–	1	–
Physics:					
Electricity.................	331	2	–	2	–
Statics....................	21	2	–	–	–
Properties of Matter;					
Mechanics and Heat......	650, 651	3	4	3	4
Physical Education...........	640	–	2	–	2

CIVIL ENGINEERING

(Course 1)

The normal course in Civil Engineering has been so designed as to be broad and comprehensive, with a view to meeting not only the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire a technical training of such a basic character as to enable them to enter various other fields of technical employment. Concurrent with the instruction in engineering subjects, sufficient attention is given to economic, legal, and administrative matters to make the graduate in this course fitted to enter not only upon such work as Municipal Engineering, Sanitary Engineering, Highway Engineering, Railway Engineering, Geodetic Surveying, Structural Engineering, and Hydraulic Engineering, but also upon administrative and executive work in both engineering and industrial undertakings.

The subjects of instruction are shown in the following tables. In these tables reference numbers have ben assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION B, see page 31.

Second Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Physics	70, 71	2	3	–	–
Calculus	491	2	–	2	–
Descriptive Geometry	272	2	–	–	–
Dynamics	22	1	–	1	–
Economics	311	2	–	2	–
Electric Circuits and Machines	347, 348	1	–	2	$1\frac{1}{2}$
Engineering Chemistry	226	2	–	–	–
Engineering Problems and Drawing	284	–	$10\frac{1}{2}$	–	6
Least Squares	494	–	–	–	3
Mechanics of Materials	23, 31	2	–	2	3
Physical Metallurgy	538	–	–	2	–
Practical Astronomy	200	1	–	1	–
Practical Experience	690	–	–	–	–
Surveying	714, 716	2	3	1	3

Third Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Elasticity	33, 34	1	1½	1	1½
Cements and Concrete	35, 44	2	3	1	–
Construction Surveying (1960–61 only)	718	–	–	2	–
Control Surveys	201	–	–	1	–
Differential Equations	507, 516	1	1½	1	1½
Engineering Geology	382, 383	2	2	2	2
Engineering Thermodynamics	434	2	–	1	–
Fluid Mechanics	440, 441	2	–	2	3
Modern World History	324	2	–	2	–
Municipal Planning, Administration and Transportation	216	2	–	1	–
Photogrammetry	75	–	3	–	–
Practical Experience	690	–	–	–	–
Structural Engineering	28, 51	2	6	2	6
Survey Camp	720	–	–	–	–

Students in Civil Engineering are required to state not later than June 30th following the completion of their Third Year the options they desire to pursue in the Fourth Year. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Fourth Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Construction Management (1960–61 only)	218	1	–	–	–
Construction Management and Business (Starting 1961–62)	218	–	–	2	–
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Highway Engineering	217	1	–	1	–
Hydraulic Engineering	445, 446	2	1½	2	3
Municipal Planning, Administration and Transportation (1960–61 only)	216	2	–	1	–
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Reinforced Concrete	41, 42	2	1½	1	1½
Sanitary Engineering (1960–61 only)	214, 215	1	1½	2	3
Sanitary Engineering (Starting 1961–62)	214, 215	2	1½	2	3
Thesis and Public Speaking*	730	–	–	–	1
And either of the following groups of subjects:					
Group A					
Mechanics of Materials	38	–	3	–	3
Soil Mechanics and Foundations	40, 50	2	–	2	3
Structural Design	43, 54	1	3	1	3
Theory of Structures	36, 37	2	1½	2	1½
Group B					
Adjustment of Observations	523	–	–	–	3
Astronomy	202, 203	1	3	–	–
Geodesy	204, 205	–	–	2	3
Photogrammetry	77, 78	1	3	1	3
Soil Mechanics and Foundations	49, 50	1	–	1	3
Survey Camp	721	–	–	–	–
Town and Regional Planning	219, 220	1	3	–	–

*Topic for Thesis must be submitted by each student for approval not later than Oct. 15, and preferably by the beginning of the first term. The final date for submission of completed, typed thesis is the last day of the first term.

MINING ENGINEERING

(Course 2)

The course in Mining Engineering provides a broad training in the fundamentals of engineering.

The graduate is therefore well prepared to enter any of the many phases of the mineral industry such as the exploration and development of new mineral areas, the mining of mineral deposits by both surface and underground methods, and the milling and metallurgical treatment of the ores and products. The field of the engineer in the mining of precious metals, copper, lead, zinc and nickel in Canada is now augmented by the production of iron, titanium and uranium. Engineering is also increasingly important in the mining and treatment of industrial minerals such as asbestos, limestone and gypsum. Moreover, the expanding world market for mineral products is necessitating the utilization of ore deposits which require the application of the most advanced technological methods.

The course in Mining combines in well balanced proportions, studies in the fields of mathematics, geology, chemistry, structures, mechanics, electricity, metallurgy, and economics and business, together with courses having particular reference to mining. In view of the large proportion of mining graduates employed in production and supervision, the administrative viewpoint is emphasized throughout the course.

With such diversified training, the Mining Engineer is capable of successful participation in all branches of industry and commerce.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION B, see page 31.

Second Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	227	–	6	–	–
Calculus	491, 287	2	1½	2	1½
Chemistry	224	2	–	–	–
Economics	311	2	–	2	–
Electric Circuits and Machines	347, 348	1	–	2	1½
Historical and Stratigraphic Geology	393	–	–	2	1
Mechanics of Materials	23, 31	2	–	2	3
Mineralogy and Lithology	386, 387	2	2	2	2

Second Year Subjects Course 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Mining	165	–	–	1	2
Oral Expression	193	–	–	–	2
Physical Geology	380, 381	2	3	–	–
Practical Experience	690	–	–	–	–
Surveying	715, 717	1	3	2	2

Third Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 161	1	3	1	3
Business	310	–	–	1	–
Elementary Structural Engineering	29, 53	1	–	2	3
Fluid Flow and Pumping Systems	454, 455	3	3	–	–
Geological Field Work	411	–	–	–	–
Heat Engines, Theory	427, 428	1	–	1	3
Metallurgy	539	–	–	1	–
Mineral Dressing	180, 182	2	–	2	6
Mining	168	3	–	–	–
Mining Laboratory	169	–	3	–	3
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–
Structural Geology	397, 398	1	3	1	3
Summer Essays	192	–	2	–	–
Survey Camp	720	–	–	–	–
Wet Analysis	162	–	3	–	3

Fourth Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Glacial Geology and Ground Water	384, 412	1	–	1	–
Machine Design	469, 470	1	–	1	3
Metallurgy	555, 556	1	–	1	3
Mine Operation and Administration	170, 172	2	2	2	6
Mineral Deposits	399	2	–	2	–
Mine Ventilation	175, 176	2	3	–	–
Mining Geology	405	–	–	2	–
Ore Dressing	183, 184	1	6	1	–
Physical Metallurgy	538	–	–	2	–
Practical Experience	690	–	–	–	–
Precambrian Geology	403	2	1	–	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	$5\frac{1}{2}$	–	6

MECHANICAL ENGINEERING

(Course 3)

The mechanical engineer is concerned with the production and the use of power, and it is part of his work to design and manufacture suitable machinery for this purpose, and to install and operate it. The internal combustion engine and the steam turbine are the products of his effort, and he applies these prime movers to automobiles, aeroplanes, locomotives, and other purposes. His work also includes the design of water turbines and their use in hydro-electric systems.

Other branches of his work are the making of designs for air compressors, machine tools, pumps, refrigerating machines and their application to storage warehouses and ice-making, heating and ventilating equipment, materials-handling and conveying plants, and generally all mechanical work. General industrial and administrative problems are considered.

The course of study has been devised to equip men for work in the general field of mechanical engineering.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION A, see page 31.

Second Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	367, 368	–	–	2	1½
Calculus....................	491	2	–	2	–
Dynamics of Machines........	465, 466	3	1½	3	1½
Economics..................	311	2	–	2	–
Electricity..................	338, 334	2	3	–	–
Engineering Chemistry........	226	2	–	–	–
Engineering Problems and Drawing...............	286	–	6	–	6
Heat Engines, Elementary.....	420	–	–	2	–
Mechanical Engineering.......	461	1	–	–	–
Mechanics of Materials.......	23, 31	2	3	2	–
Physical Metallurgy..........	564, 565	2	–	2	1½
Practical Experience..........	690	–	–	–	–
Treatment of Technical Data..	449	–	–	2	–

Third Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Business	310	–	–	1	–
Differential Equations	511	2	1½	2	3
Electronics	345, 346	2	1½	–	–
Electrical Machines	377, 378	2	1½	2	3
Fluid Mechanics	440, 441	2	–	2	3
Heat Engineering	422	2	–	1	–
Heat Engines, Theory	421, 423	2	3	2	3
Machine Design	467, 468	2	4½	2	6
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–

Fourth Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Engineering	520	1	3	2	3
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Heat Engine Laboratory	426	–	3	–	5
Heat Power Engineering	424	2	–	2	–
Physical Metallurgy	564, 565	2	–	2	1½
Hydraulics	443, 444	2	3	2	6
Industrial Management	315	1	–	–	–
Internal Combustion	425	1	–	1	–
Machine Design	473, 474	2	5	2	5
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Thesis	730	–	1	–	1

INDUSTRIAL ENGINEERING

(Course 4)

The Industrial Engineering course, like the other engineering courses at the University of Toronto, is primarily an education for the profession of engineering. The student is given a substantial foundation in science and mathematics, and in such fundamental engineering subjects as fluid mechanics, applied thermodynamics, electricity, mechanics of materials and machine design.

At the same time, the Industrial Engineering student undertakes a specialization in industrial and engineering analysis. This includes studies in probability and statistics, numerical analysis, operations research, data processing and control theory. Emphasis is placed on the application of these methods in both the economic and technical aspects of industry, and in automatic systems. The student is also introduced to such studies as organizational structure, financial control and industrial psychology.

The course in Industrial Engineering has superseded the course in Engineering and Business. The Fourth Year Industrial Engineering curriculum, for the 1960–61 session only, represents a transition from Engineering and Business to Industrial Engineering.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION A, see page 31.

Second Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	367, 368	–	–	2	1½
Calculus....................	491	2	–	2	–
Dynamics..................	22	–	–	2	–
Economics.................	311	2	–	2	–
Electricity..................	338, 334	2	3	–	–
Engineering Chemistry........	226	2	–	–	–
Engineering Problems and Drawing..................	288	–	6	–	6
Mechanical Engineering.......	463, 464	2	–	2	3
Mechanics of Materials.......	23, 31	2	3	2	–
Practical Experience..........	690	–	–	–	–
Probability and Statistics.....	512, 513	2	3	2	3
Physical Metallurgy..........	564, 565	2	–	2	1½

Third Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Accounting..................	306	2	–	2	–
Differential Equations........	511	2	–	2	–
Electronics..................	345, 346	2	1½	–	–
Elementary Structural Engineering................	29, 53	1	–	2	3
Fluid Mechanics.............	440, 441	2	3	2	–
Heat Engines, Theory........	435, 423	–	–	2	3
Industrial Psychology.........	327	–	–	2	–
Machine Design..............	467, 468	2	3	2	3
Modern World History........	324	2	–	2	–
Numerical Analysis...........	514, 515	2	3	2	3
Practical Experience..........	690	–	–	–	–

FOURTH YEAR SUBJECTS COURSE 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Elementary Control Theory....	480, 481	2	3	2	3
Electric Machines............	342, 343	2	3	–	–
Engineering Data Processing...	678, 679	2	3	–	–
Engineering Law.............	314	1	–	–	–
English.....................	611	1	–	1	–
Industrial Management.......	320, 322	2	3	2	3
Manufacturing Processes......	476, 477	–	–	2	3
Operations Research I........	524, 525	2	3	2	3
Operations Research II.......	526, 527	–	–	2	3
Philosophy of Science.........	326	2	–	–	–
Practical Experience..........	690	–	–	–	–
Thesis......................	730	–	2	–	2

The Fourth Year subjects, as shown above, will commence in the session 1961–62.

(For Fourth Year, session 1960–61, see below.)

FOURTH YEAR SUBJECTS COURSE 4 SESSION 1960–61 ONLY	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Elementary Control Theory....	480, 481	2	3	2	3
Electric Machines............	342, 343	2	3	–	–
Engineering Law.............	314	1	–	–	–
English.....................	611	1	–	1	–
Industrial Management.......	320, 322	2	3	2	3
Manufacturing Processes......	476, 477	2	3	2	3
Numerical Analysis...........	514, 515	2	3	2	3
Philosophy of Science.........	326	2	–	–	–
Physical Metallurgy..........	564, 565	2	–	2	$1\frac{1}{2}$
Practical Experience..........	690	–	–	–	–
Thesis......................	730	–	2	–	2

ENGINEERING PHYSICS

(Course 5)

Admission to and promotion in this course is granted only to students who meet the special requirements set forth on page 21 of this Calendar.

The course is designed to afford a training in Mathematics and Physics beyond that which it is possible to give in the other undergraduate courses in engineering. It is believed that a wider and more thorough acquaintance with the basic sciences will bring to the student a readier appreciation of the nature of the technical problems with which he will later be confronted and a greater facility in the solution of them. A course of the kind offered should consequently be of particular value to those who desire to enter governmental or industrial research laboratories, or who wish to engage in any original work of investigation or development in the field of applied physics.

Throughout the four years of the course an effort is made to maintain the practical point of view in the theoretical instruction. This is effected, in part, by adopting wherever possible the engineering viewpoint in the teaching of mathematical and scientific subjects, and, in part, by the inclusion of certain basic engineering instruction.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION C, see page 31.

Second Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Calculus	504	2	–	2	–
Dynamics	25	1	–	1	–
Economics	311	2	–	2	–
Electric Circuits	354, 356	2	1½	2	1½
Inorganic Chemistry	237	2	–	1	–
Integral Calculus and Differential Equations	505	2	–	2	–
Mathematical Problems	495	–	3	–	3
Mechanics of Materials	24, 31	2	–	1	3
Physical Chemistry	238	1	–	2	–
Physics	652, 655	3	6	3	3
Probability and Numerical Methods	501	2	–	2	–

Third Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mechanics	27	2	–	2	–
Differential Equations	509	1	1	1	1
Electronics	366, 379	2	–	2	1½
Modern World History	324	2	–	2	–
Physical Laboratory	659	–	3	–	3
Thermodynamics and Kinetic Theory	657	2	–	2	–
Theory of Functions	508	1	1	1	1
And *one* of the following options which must be continued in the Fourth Year.					
Option 5a, Aeronautics					
Aircraft Propulsion	9,14	2	–	2	1
Analysis of Structures	7, 8	2	3	1	1½
Fluid Mechanics	12, 15	2	1½	2	1½
Physical Metallurgy	561	1	–	1	–
Option 5c, Chemical					
Chemical Theory B	240	2	–	2	–
Chemical Laboratory	249	–	6	–	6
Fluid Mechanics	12, 15	2	1½	2	1½
Physical Metallurgy	561	1	–	1	–
Option 5e, Electricity					
Acoustics	97, 98	2	1½	–	–
Electrical Machines	377, 378	2	1½	2	3
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	561	1	–	1	–
Physics of Solids and Fluids	656	1	–	1	–
Option 5g, Geophysics					
Physical Geology	381	–	3	–	–
Mineralogy and Lithology	386, 387	2	2	2	2
Physical Metallurgy	561	1	–	1	–
Physics of Solids and Fluids	656	1	–	1	–
Physics of the Earth	674	1	–	1	–
Structural Geology	397, 398	1	3	1	3
Option 5m, Physical Metallurgy					
Crystallography	390	1	–	1	–
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	533, 534	2	3	2	3
Physics of Solids and Fluids	656	1	–	1	–
Option 5n, Atomic Energy					
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	561, 534	1	3	1	3
Fluid Mechanics	12, 15	2	1½	2	1½
Option 5s, X-Rays and Spectroscopy					
Crystallography	390	1	–	1	–
Geometrical Optics	660, 661	1	3	1	–
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	561	1	–	1	–
Physics of Solids and Fluids	656	1	–	1	–
Option 5t, Thermodynamics					
Fluid Mechanics	12, 15	2	1½	2	1½
Heat Engineering	422, 423	2	3	2	3
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	561	1	–	1	–

Students in Engineering Physics are required to state at the beginning of the Third Year the options they desire to pursue in the Third and Fourth Years. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Fourth Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5a, Aeronautics					
Aircraft Design	3, 4	2	3	2	3
Analysis of Structures	5, 6	2	3	2	3
Applied Aerodynamics	1, 2	2	$4\frac{1}{2}$	2	$4\frac{1}{2}$
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
English	611	1	–	1	–
Gasdynamics	13, 16	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Philosophy of Science	326	2	–	–	–
Thesis	730	–	–	–	–
Option 5c, Chemical					
Atomic Physics	663	3	–	3	–
Chem. Eng. Laboratory	252	–	6	–	9
Chem. Eng. Thermodynamics and Kinetics	256	2	–	2	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Diffusion and Mass Transfer	261	2	–	2	–
English	611	1	–	1	–
Heat Power Engineering	430	1	–	1	–
Organic Chemistry	250, 258	2	3	2	–
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5e, Electricity					
Atomic Physics	663	3	–	3	–
Circuit Analysis	350	2	–	2	–
Communications I	360, 361	3	3	–	–
Communications II	362, 363	–	–	3	3
Communications III	371	–	–	2	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electric Control Systems	357, 358	2	1½	1	1½
English	611	1	–	1	–
Electromagnetic Theory, Applied	365	2	–	2	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	–	–	–
Option 5g, Geophysics					
Atomic Physics	663	3	–	3	
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Geophysical Methods	670, 672	2	6	2	6
Glacial Geology	384	1	–	1	–
Mineral Deposits	399	2	–	2	–
Petroleum Geology	407, 408	2	–	2	3
Philosophy of Science	326	2	–	–	–
Physics of the Earth	675	1	–	1	–
Thesis	730	–	–	–	–

FOURTH YEAR SUBJECTS COURSE 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5m, Physical Metallurgy					
Atomic Physics	663	3	–	3	–
Communications I	360, 361	3	3	–	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Metal Physics Seminar	563	–	3	–	3
Operational Methods	364	2	–	2	–
Physical Metallurgy	557, 562	2	–	2	3
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–
X-Ray Crystallography	415	–	–	2	–
Option 5n, Atomic Energy					
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electric Control Systems	357, 358	2	1½	1	1½
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Gas Dynamics	13, 16	2	1½	2	1½
Heat Transfer	433	1	–	1	–
Nuclear Reactor Theory	664	2	–	2	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Options 5s, X-Rays and Spectroscopy					
Atomic Physics	663	3	–	3	–
Communications I	360, 361	3	3	–	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Operational Methods	364	2	–	2	–
Optics, Advanced	666	2	–	2	–
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	9	–	9
Quantum Mechanics	669	1	–	1	–
Thesis	730	–	–	–	–
Option 5t, Thermodynamics					
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
English	611	1	–	1	–
Gas Dynamics	13, 16	2	1½	2	1½
Heat Engineering Laboratory	426	–	3	–	3
Heat Power Engineering	430	1	–	1	–
Heat Transfer	433	1	–	1	–
Refrigeration and Air Conditioning	429	1	–	1	–
Internal Combustion Engines	425	1	–	1	–
Machine Design	478	1	–	1	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	–	–	–
Vibration Engineering	99, 100	1	3	1	3

CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(COURSE 6)

The chemical engineer is concerned with the development and operation of processes by means of which matter is chemically altered to a more useful form, and in the design, construction, operation and management of plant in which to effect such changes. Apart from such obviously chemical processes as those concerned with the production of acids, alkalis, salts, petroleum, rubber products, pulp and paper, explosives, paints and varnishes, soap, plastics, etc., there are many industrial processes where chemistry plays a part, or where a knowledge of chemistry is valuable. There is thus a wide field of endeavour for the chemical engineer. In order to equip a student to enter this field, the course in chemical engineering is intended to provide the student with training in the principles of the major divisions of chemistry and chemical engineering, together with an understanding of such other engineering subjects as thermodynamics, hydraulics, electricity, mechanics of materials, and machine design.

As part of the work of the Fourth Year each student is assigned a problem involving original investigation, in order to let him apply to some extent what he has learned, and to introduce him to the chemical literature. It also serves as an introduction to research for those who are attracted to it, and who, because of their basic training are equipped to carry on research in chemistry or chemical engineering at the graduate level or in laboratories outside the university.

For those students considering taking up the teaching of science as a profession, the nature and extent of the thesis subject in the Fourth Year may be modified to allow the student to take such other instruction as may be necessary to shorten the time required before becoming professionally qualified.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION A, see page 31.

Second Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	232, 233	2	9	–	–
Analytical Chemistry Laboratory	229	–	–	–	–
Calculus	491, 287	2	1½	2	1½
Chemical Engineering Science Laboratory	235	–	–	–	12
Economics	311	2	–	2	–
Electrical Engineering	375, 376	2	3	2	3
Industrial Chemistry	230	2	–	1	–
Inorganic Chemistry	231	1	–	2	–
Mechanics of Materials	23	2	–	2	–
Organic Chemistry	234	1	–	2	–
Physical Chemistry	236	2	–	2	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory	249	–	6	–	6
Chemical Theory A	239	1	–	1	–
Chemical Theory B	240	2	–	2	–
Differential Equations	507	1	–	1	–
Fluid Mechanics	452, 453	2	3	–	–
Heat Engines, Theory	431, 423	2	–	–	3
Industrial Chemistry	241	–	–	3	–
Introduction to Mass and Heat Transfer	242	2	–	2	3
Modern World History	324	2	–	2	–
Organic Chemistry	244, 245	2	9	2	6
Practical Experience	690	–	–	–	–
Public Speaking	319	–	1	–	1

Fourth Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Chemical Engineering	255	–	3	–	–
Chemical Engineering Thermodynamics and Kinetics	256	2	–	2	–
Chemical Engineering Laboratory	251	–	10	–	–
Chemical Plant Design	254	1	–	–	3
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Fluid Mechanics (1960–61 only)	452, 453	2	3	–	–
Industrial Management	315	1	–	–	–
Machine Design	479, 470	2	–	1	3
Mass Transfer Operations	253	2	–	2	–
Organic Chemistry	257	1	–	1	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	3	–	18

ELECTRICAL ENGINEERING

(Course 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields in addition to that of applying things electrical for the benefit of humanity. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also heat engines, hydraulics, theory of mechanisms, machine design, business, economics, engineering law, and other non-electrical subjects.

In the electrical field much time is given to the calculation of circuits of electric, magnetic, and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets, and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial, or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION A, see page 31.

Second Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Physics	70, 71	–	–	2	3
Chemistry	225	2	–	–	–
Calculus and Differential Equations	493	2	2	2	2
Dynamics	26, 32	2	1½	1	1½
Economics	311	2	–	2	–
Electric Circuits I	332	3	2	3	2
Electric and Magnetic Fields	333	2		2	
Electrical Measurements	340	–	–	2	–
Electrical Laboratory	334	–	–	–	6
Mechanics of Materials	24, 31	2	3	1	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits II	341	2	–	2	–
Business	310	–	–	1	–
Direct Current Machines	339	2	–	–	–
Electrical Problems	335	–	2	–	4
Electrical Laboratory	344	–	3	–	3
Electronics	337, 379	2	–	2	1½
Heat Engines, Theory	421, 423	2	3	2	–
Fluid Mechanics	440, 441	2	3	2	–
Machine Design	475, 468	–	–	2	3
Mathematical Applications in Electrical Engineering	336	2	–	2	–
Modern World History	324	2	–	2	–
Physical Metallurgy	566	2	–	–	–
Practical Experience	690	–	–	–	–

Fourth Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Machinery I	353	3	–	–	–
Circuit Analysis	351	2	–	3	–
Communications I	360, 361	3	3	–	–
Electrical Laboratory	355	–	3	–	1½
Electrical Problems and Seminar	359	–	2	–	2
Electric Control Systems	357, 358	2	1½	1	1½
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Industrial Management	315	1	–	–	–
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Thesis	730	–	–	–	–
Transmission at Low and High Frequencies	352	3	–	–	–
And one of the following groups of subjects:					
Group A					
Acoustics	82, 83	–	–	2	1½
Communications II	362	–	–	3	–
Communications III	371	–	–	2	–
Communications Laboratory	363	–	–	–	3
Group B					
Alternating-Current Machinery II	369, 370	–	–	2	1½
Electric Power Systems	373	–	–	2	2
Illumination	93, 94	–	–	2	3

METALLURGICAL ENGINEERING

(Course 8)

No other materials approach the metals in strength, and the whole fabric of modern civilization is dependent on their properties. The fields of employment for graduates lie in production metallurgical industries, the industries which fabricate metals, and in sales and research. Metallurgical research facilities have notably been increased in recent years in Canada.

The metallurgical engineer is concerned with the winning of metals from ores. Since virgin metals rarely possess useful physical properties, the second task of the metallurgist is to produce alloys, such as steel, which have suitable physical properties.

Both physical and extractive metallurgy are based upon the sciences of chemistry and physics. It is believed that a wider knowledge of the basic sciences will bring to the student a readier appreciation of the technical problems with which he will be later confronted and a greater facility in their solution. To achieve this end, greater emphasis is placed upon physics and chemistry in the earlier years of the course. It follows that this course will be of greater value to students who have obtained a good standing in mathematics and science. In addition to instruction in extractive and physical metallurgy, engineering subjects are provided to give a general knowledge of mechanics of materials, machine design, etc. The course includes the non-technical subjects, such as Economics and English, which are common to all courses in the Faculty.

Courses in production metallurgy cover the theory and practice of winning aluminium, copper, iron, lead, magnesium, nickel, zinc, etc., from their ores. Physical Metallurgy courses cover the structure and properties of alloys, including microscopic, x-rays and mechanical methods of investigation.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION A, see page 31.

Second Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	228	–	4	–	4
Calculus	491	2	–	2	–
Economics	311	2	–	2	–
Electrical Engineering	375, 376	2	3	2	3
Engineering Problems and Drawing	289	–	3	–	3
Inorganic Chemistry	231	1	–	2	–
Mechanics of Materials	23, 31	2	3	2	–
Metallurgy	530	2	–	2	–
Metallurgy Problems	540	–	–	–	2
Optics	72, 73	1	3	1	3
Physical Chemistry	236	2	–	2	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 164	1	3	1	–
Crystallography	390	1	–	1	–
Differential Equations	507	1	–	1	–
Electrochemistry	246, 247	2	$1\frac{1}{2}$	–	–
Metallurgical Problems Laboratory	536	–	4	–	4
Metallurgical Thermodynamics I	535	2	–	2	–
Mineral Dressing	180, 181	2	–	2	6
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–
Principles of Extractive Metallurgy	531, 532	2	3	2	6
Principles of Physical Metallurgy	533, 534	2	3	2	3

Fourth Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Extractive Metallurgy Laboratory	552	–	6	–	–
Ferrous Extractive Metallurgy	551	1	–	1	–
Fluid Mechanics	452	2	–	–	–
Heat Transfer	432	–	–	2	–
Machine Design	469, 470	1	–	1	3
Metallurgical Thermodynamics II	553	2	–	2	–
Metallurgical Problems Laboratory	554	–	2	–	2
Non-Ferrous Extractive Metallurgy	550	1	–	1	–
Ore Dressing	183	1	–	1	–
Philosophy of Science	326	2	–	–	–
Physical Metallurgy	557, 558	2	6	2	3
Practical Experience	690	–	–	–	–
Statistics	510	2	–	–	–
Thesis	730	–	3	–	12

APPLIED GEOLOGY

(Course 9)

The expanding Canadian economy is making ever growing demands on the Mineral Industry for raw products—iron, copper, uranium, gas, petroleum, etc. Geologists play an important part in this industry. They belong to a team—whose other members are mining engineers and metallurgists—responsible for finding new deposits of metals, mining them, and extracting the metals from the ores. In addition, geologists are widely employed in the petroleum industry.

The course in Applied Geology provides a training in the fundamentals of the geological sciences and graduates in this course are suitably trained to enter the ranks of professional geologists. Students also take work with related departments, such as Mining Engineering, Metallurgical Engineering, Chemical Engineering and Civil Engineering, and in this way have some knowledge of other fields of engineering.

The geological subjects are selected so that they will carry the student through from an introductory course to a stage where he has a useful knowledge of the broad field of the subject. He is properly trained to find employment in mining geology, petroleum geology, or engineering geology. Such work may be with exploration companies, oil companies or mining companies.

Graduates in Applied Geology who wish further specialized training in geology may proceed to the M.A.Sc. or Ph.D. degrees, and thus qualify themselves for employment with government geological surveys or as university teachers.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 85.

For FIRST YEAR CURRICULUM—DIVISION B, see page 31.

SECOND YEAR SUBJECTS COURSE 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	227	–	6	–	–
Calculus	491, 287	2	1½	2	1½
Chemistry	224	2	–	–	–
Economics	311	2	–	2	–
Historical and Stratigraphical Geology	393, 394	–	–	2	3
Mechanics of Materials	23, 31	2	–	2	3
Mineralogy and Lithology	386, 387	2	2	2	2
Mining	165	–	–	1	2
Optics	72, 73	1	3	1	3
Oral Expression	193	–	–	–	2
Physical Geology	380, 381	2	3	–	–
Practical Experience	690	–	–	–	–
Surveying	715, 717	1	3	2	2

Third Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 161	1	3	1	3
Business	310	–	–	1	–
Descriptive Mineralogy	388	–	2	–	2
Elementary Geochemistry	385	2	–	2	–
Geological Field Work	411	–	–	–	–
Metallurgy	539	–	–	1	–
Mineral Dressing	186	2	–	–	–
Mining	168	3	–	–	–
Modern World History	324	2	–	2	–
Ore Microscopy	389	–	–	–	3
Palaeontology	395, 396	2	2	2	2
Petrology	391, 392	3	2	2	2
Practical Experience	690	–	–	–	–
Stratigraphy and Sedimentation	409, 410	–	–	2	2
Structural Geology	397, 398	1	3	1	3
Survey Camp	720	–	–	–	–

Fourth Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Geology of Canada	401	1	–	1	–
Geological Field Trips	412, 413, 414	–	–	–	–
Geophysics	671, 673	1	3	1	3
Metallurgy	555	1	–	1	–
Mineral Deposits	399, 400	2	–	2	3
Mine Operation and Administration	170, 173	2	–	2	3
Mining Geology	405, 406	–	3	2	–
Petroleum Geology	407, 408	2	–	2	3
Pleistocene Geology	402	2	–	2	–
Practical Experience	690	–	–	–	–
Precambrian Geology	403, 404	2	3	–	3
Philosophy of Science	326	2	–	–	–
Thesis	730	–	6	–	–

AERONAUTICAL/ASTRONAUTICAL ENGINEERING

A five year program of study has been designed to prepare the student for a career in aeronautical/astronautical engineering. It includes the following elements: (a) an introduction to the fundamentals of mathematics, physics, and chemistry, (b) an introduction to aerodynamics, instrumentation, propulsion, structures and design, and (c) an advanced treatment of the subjects required for modern design and research in aeronautics/astronautics such as hypersonic aerodynamics, flight dynamics, and space propulsion. Under (a) and (b) the student's training is necessarily broad and basic. The more advanced knowledge needed for the research, development, and design relevant to new aircraft, and spacecraft is provided under (c) and is of particular significance. It is possible to provide (a) and (b) in a four-year undergraduate course, but the final intensive training under (c) must be left for a graduate year.

The program of study that leads to status as a well-qualified aeronautical/astronautical engineer has been established in two parts as follows:

(i) *Undergraduate Course.* The student registers in the course in Engineering Physics, subject to the entrance requirements given on page 20 of this Calendar. This course provides the requisite training in the fundamental sciences (see (*a*) above). The advanced subjects contained in the Aeronautics option given in the third and fourth years are taught by the staff of the Institute of Aerophysics (see (*b*) above). The student will receive the degree of Bachelor of Applied Science upon completion of this part of the program.

(ii) *Graduate Course.* The student will then continue his five year program (*see* (*c*) above) in the Department of Aeronautics and Astronautics, School of Graduate Studies, as a candidate for the degree of Master of Applied Science in Aeronautical/Astronautical Engineering. During this year the student has a choice of taking one of two options consisting of at least four courses and a review thesis or at least two courses and a research or development thesis. Details regarding entrance regulations and courses of study are given in the Calendar of the School of Graduate Studies. The facilities of the Institute of Aerophysics are available to the student. For details of research projects, assistantships, scholarships and demonstratorships, students should consult the Director of the Institute of Aerophysics.

It should be noted that a student who has graduated in another branch of engineering and who desires to become an aeronautical/astronautical engineer may proceed directly with (ii) above, but in this case the course leading to the M.A.Sc. degree must be arranged so that deficiences in his undergraduate training are made up.

The facilities of the Institute of Aerophysics are available for further graduate study leading to the Ph.D. Degree.

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 221, Chemistry, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 31.

Where laboratory reports are to be written outside of assigned laboratory hours, the maximum number of such reports is indicated in the description of the laboratory course concerned.

INSTITUTE OF AEROPHYSICS

1. Applied Aerodynamics. B. Etkin.

Course 5a, IV Year; 2 hrs. lectures per week, both terms.

Two dimensional airfoil theory; finite wing theory; performance calculation; stability and control.

Reference books: Airfoil and Airscrew Theory—Glauert. Dynamics of Flight—B. Etkin. Airplane Performance, Stability and Control—Perkins & Hage. Foundations of Aerodynamics—Kuethe & Schetzer.

2. Applied Aerodynamics Laboratory. B. Etkin, G. K. Korbacher.

Course 5a, IV Year; 4½ hrs. laboratory per week, both terms.

Part of the time allotted is spent in the drafting room working problems on applied aerodynamics. The remainder is spent in the wind-tunnel laboratory, where experiments are conducted to illustrate the principles of fluid mechanics, and to demonstrate typical aerodynamic data.

One laboratory report per week.

Reference book: Wind Tunnel Testing—Pope.

3. Aircraft Design. R. D. Hiscocks.

Course 5a, IV Year; 2 hrs. lectures per week, both terms.

Design problems are worked out by the students in conjunction with the lectures. Typical structural flight envelopes are derived for low and high speed airplanes. The origin and magnitude of loads which are critical in the design of various components are considered. Specific problems include the detail design of riveted and bolted joints. The importance of good detail design in avoiding fatigue troubles is emphasized and aeroelastic phenomena are considered.

4. Aircraft Design Laboratory. R. D. Hiscocks.

Course 5a, IV Year; 3 hrs. laboratory, both terms.

Problems based on the lectures in subject 3 are worked out during these periods.

5. Analysis of Structures. E. D. Poppleton.

Course 5a, IV Year; 2 hrs. lectures per week, both terms.

Analysis of statically indeterminate structures; energy theorems; stability and post-buckling behaviour of columns, plates and thin-walled beams, beam-columns; shear lag; stress function in two dimensions; dynamic, aeroelastic and thermal effects.

Reference books: Aircraft Structures—Peery. Aircraft Structural Mechanics—Steinbacher and Gerard.

6. Analysis of Structures. E. D. Poppleton.

Course 5a, IV Year; 3 hrs. laboratory per week, both terms.

Application of the theory given in the lectures of subject 5 to various problems taken from aircraft practice.

7. Analysis of Structures. E. D. Poppleton.

Course 5a, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

An introduction to the analysis of structures typical of modern aircraft and missiles. Stress distribution in beams; shear flow in thin-web beams and shells due to bending and torsion; simple redundant structures; deflection of structures; analysis of plane stress and strain.

Reference books: Resistance of Materials—Seely and Smith. Aircraft Structures—Peery.

8. Analysis of Structures. E. D. Poppleton.

Course 5a, III Year; 3 hrs. laboratory per week, first term; 3 hrs. laboratory, alternate weeks, second term.

Problems based upon the lectures in subject 7 are worked out during these periods.

9. Aircraft Propulsion. G. K. Korbacher.

Course 5a, III Year; 2 hrs. lectures per week, both terms.

Thermodynamic and aerodynamic fundamentals of gas turbines, jet engines, rocket motors, pulse and ram jets—thrust, propulsion power and efficiency, blade theory; turbine, compressor, and combustion chamber design features and performance.

Reference books: Jet Propulsion and Gas Turbines—Zucrow. Gas Turbine Theory—Cohen and Rogers.

12. Fluid Mechanics. J. H. de Leeuw.

Courses 5a, 5c, 5n, 5t, III Year; 2 hrs. lectures per week, both terms.

Introductory aerodynamics; calculus of vector fields; inviscid flow equations; examples of incompressible fluid flow including applications of complex variables; fundamentals of compressible flow; viscous flows including drag and boundary layers.

Reference books: Fluid Dynamics—Streeter. Fundamentals of Hydro- and Aeromechanics—Prandtl and Tietjens. Principles of Aerodynamics—Dwinnell.

13. Gasdynamics. I. I. Glass.

Courses 5a, 5n and 5t, IV Year; 2 hrs. lectures per week, both terms.

Introductory thermodynamics of perfect and imperfect gases, equations of motion and their application to nozzles, diffusers and supersonic wind tunnels; expansion waves; normal, oblique and conical shock waves; skin friction and heat transfer in boundary layers and ducts; aerodynamic measurements.

Reference books: Elements of Gasdynamics—Liepmann and Roshko. Dynamics and Thermodynamics of Compressible Fluid Flow—Shapiro. An Introduction to Fluid Mechanics and Heat Transfer—Kay.

14. Aircraft Propulsion Laboratory. G. K. Korbacher.

Course 5a, III Year: Four 3 hrs. laboratory periods, second term.

This time is used to give students experience with jet engines, dismantled components, test bed facilities and engine testing.

Three laboratory reports required.

15. Fluid Mechanics Laboratory. J. H. de Leeuw.

Courses 5a, 5c, 5n, 5t, III Year; 3 hrs. laboratory alternate weeks, both terms.

Problems based on the lectures of subject 12 are worked out during these periods.

16. Gasdynamics Laboratory. I. I. Glass.

Courses 5a, 5n and 5t, IV Year; 3 hrs. laboratory, alternate weeks, both terms.

Problems based on the lectures of subject 13 are worked out during these periods.

APPLIED MECHANICS AND DESIGN OF STRUCTURES

20. Applied Mechanics. A. C. Davidson, M. M. Davis, J. Schwaighofer, K. Meipoom, S. M. Uzumeri.

Courses 1, 2, 3, 4, 6, 7, 8, and 9, I Year; 2 hrs. lectures per week, both terms.

This subject is divided into two parts, statics and dynamics.

Statics: The principles of statics are discussed, and applied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and the bending moments and shearing forces in beams.

Dynamics: Principles of dynamics, and application to motion of particles on straight and curved paths—work, energy, power, impulse and momentum. Plane translation and rotation of rigid bodies.

Six 3-hr. practice problem periods during the Session are provided in the 3 hr. laboratory time shown on page 31 for subjects 20, 330, and 677. Problems must be done during the laboratory period.

Text books: Applied Statics—Loudon, Morrison and Davidson. Engineering Mechanics—Vol. II—Dynamics—Higdon and Stiles —Second Edition.

21. Statics. R. A. Collins, J. D. Barber.

Course 5, I Year; 2 hrs. lectures per week, first term.

The principles of statics are discussed, and applied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and the bending moments and shearing forces in beams.

Text book: Applied Statics—Loudon, Morrison and Davidson.

22. Dynamics. G. E. Godfrey, G. F. Pearce, F. P. J. Rimrott.

Course 1, II Year; 1 hr. lecture per week, both terms.

Course 4, II Year; 2 hrs. lectures per week, second term.

Motion of a point is reviewed and extended to include Coriolis' acceleration, with applications. Equations for motion of mass in translation, rotation, and plane motion are developed, including centre of percussion. Moment of inertia of mass is studied by double integration and by the lamina method. The derivation and application of gyroscopic action is thoroughly discussed, and an introduction to static and dynamic balancing is given. Elementary vibration theory and problems in vibration isolation are discussed.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics—Part II—Meriam.

23. Machanics of Materials. M. W. Huggins, M. M. Davis, F. A. De Lory, J. D. Barber, S. M. Uzumeri.

Courses 1, 2, 3, 4, 6, 8, and 9, II Year; 2 hrs. lectures per week, both terms.

In this subject, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Text book: Elements of Strength of Materials—Timoshenko and MacCullough—Third Edition.

24. Mechanics of Materials. R. A. Collins.

Courses 5 and 7, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Basic relationships between force, stress, strain, and deflection of bodies made of various engineering materials are discussed. Beams, columns, shafts, tension members and pressure vessels are analysed and designed for strength and stiffness.

Text book: Elements of Strength of Materials—Timoshenko and MacCullough.

25. Dynamics. F. C. Hooper.

Course 5, II year; 1 hr. lecture per week, both terms.

Simple particle motion. Work and energy. Impulse and momentum. Kinematics of plane motion and Coriolis acceleration. Kinetics of translation and rotation. General kinetics of plane motion. Gyroscopic action. Simple vibrations. Gibbs' Vector Notation.

Reference books: Engineering Dynamics—Hooper and Smith. Mechanics—Part II Dynamics—Meriam.

26. Dynamics. C. L. Proctor.

Course 7, II Year; 2 hrs. lectures per week first term; 1 hr. lecture per week, second term.

Motion of a point, including Coriolis' acceleration; motion of mass; gyroscopic action; vibration and balancing; electro-mechanical analogies; Gibb's vector notation.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics, Part II—Meriam.

27. Advanced Mechanics. H. S. Ribner.

Course 5, III Year; 2 hrs. lectures per week, both terms.

Mechanics of particles: fixed axes, rotating and moving axes, rectilinear motion of rockets, orbital dynamics. Mechanics of rigid bodies: fixed axes, body-attached axes (Euler's equations), gyroscopes. Dynamics of linear systems: free and forced oscillations, coupled systems, waves on a string, Rayleigh's method for continuous systems. Lagrange's equations. Introduction to wave mechanics.

Reference books: Introduction to Theoretical Physics—Page. Principles of Mechanics—Synge & Griffith.

28. Structural Engineering. C. F. Morrison.

Course 1, III Year; 2 hrs. lectures per week, both terms.

An elementary study of the stress analysis and design of structures, structural members, and their details. Problems in analysis and design are worked out in the lectures and in the drafting room.

The work covered includes static and moving loads, steel and timber tension members, compression members and flexural members including box-girders, plate girders and continuous as well as simple span beams. Welding as a method of connecting structural steel members is studied.

Text books: Theory of Simple Structures—Shedd and Vawter. Structural Problems—Young and Morrison. Steel Construction Handbook—A.I.S.C.

29. Elementary Structural Engineering. C. E. Helwig, A. C. Davidson.

Courses 2 and 4, III Year; 1 hr. lecture per week first term; 2 hrs. lectures per week, second term.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject No. 53).

Text books: Design of Steel Structures—Gaylord & Gaylord. Steel Construction Manual—American Institute of Steel Construction. National Building Code of Canada—National Research Council, Ottawa. Timber Construction Manual—Canadian Institute of Timber Construction. Basic Reinforced Concrete Design—Large.

30. Structural Engineering. A. C. Davidson.

Course 3, IV Year; 2 hrs. lectures per week, both terms. (Not given in 1960–61.)

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject 52).

The work covered comprises: Moving loads in simply supported beams; in steel, tension and compression member details, columns, rolled steel beams, built-up beams and girders; in wood, beams, columns, and their connections; in concrete, the making of plain concrete, reinforced concrete beams, columns, slabs and footings.

Text books: Design of Steel Structures—Gaylord & Gaylord. Steel Construction Manual—American Institute of Steel Construction. National Building Code of Canada—National Research Council, Ottawa. Timber Construction Manual—Canadian Institute of Timber Construction. Basic Reinforced Concrete Design—Large.

31. Mechanics of Materials: General. W. L. Sagar, C. E. Helwig, C. W. Dillane, J. D. Barber.

Courses 1, 2, 5 and 9, II Year; 3 hrs. laboratory per week, second term.

Courses 3, 4, 7, and 8, II Year; 3 hrs. laboratory per week, first term.

An introduction to testing machines, strain and other measuring devices and standard specifications.

The experimental study of some engineering materials and structural members under external load.

No laboratory report shall be written outside the assigned teaching hours.

32. Dynamics Laboratory. C. L. Proctor.

Course 7, II Year; 1½ hrs. problems per week, both terms.

Problems in kinematics and kinetics to support subject 26.

33. Applied Elasticity. J. Schwaighofer.

Course 1, III Year; 1 hr. lecture per week, both terms.

A study of the stresses and strains in structural materials and members. The topics treated include: members subjected to direct stress, shear stress, and flexural stress, and their resulting deformations; principal stresses; statically indeterminate structures such as continuous and fixed-end beams; the moment-area theorems.

Reference books: Elements of Strength of Materials—Timoshenko and MacCullough.

34. Applied Elasticity Problems. M. W. Huggins, K. Meipoom, W. H. Sisson, S. M. Uzumeri.

Course 1, III Year; 1½ hrs. laboratory per week, both terms.

Problems supplementing lecture course 33, are worked out in the laboratory. Reports written outside the laboratory period are not accepted.

35. Cements and Concrete. C. E. Helwig.

Course 1, III Year; 2 hrs. lecture per week first term, 1 hr. lecture per week second term.

A discussion of engineering cementing materials used in construction, and a study of the basic principles of concrete making.

An introduction to the theory of design of reinforced concrete elements including beams, one way slabs, columns, footing, retaining walls.

Text book: Reinforced Concrete Fundamentals—Ferguson.

36. Theory of Structures. C. F. Morrison.

Course 1a, IV Year; 2 hrs. lectures per week, both terms.

The stress analysis of simple span, continuous, and cantilever trusses. Influence lines and index stresses. Truss deflections by analytical and graphical methods. Arches, suspension bridges, and statically indeterminate structures.

Text books: Theory of Simple Structures—Shedd and Vawter. Structural Theory—Sutherland and Bowman.

37. Theory of Structures: Problems. C. F. Morrison, R. A. Collins, A. C. Davidson, S. M. Uzumeri.

Course la, IV Year; 1½ hrs. laboratory work per week, both terms.

Problems are worked out in the laboratory following the lecture course 36. Reports written outside the laboratory period are not accepted.

38. Mechanics of Materials. General. W. L. Sagar, C. E. Helwig, C. W. Dillane, J. D. Barber, K. Meipoom.

Course 1a, IV Year; 3 hrs. laboratory per week, both terms.

The behaviour of various engineering materials under load. Verification of testing machines. The use of precision instruments in the determination of stress-strain relationships. A study of reinforced concrete beams in flexure and shear. The behaviour of some typical structural units under load. Non-destructive tests.

No laboratory report shall be written outside the assigned teaching hours.

40. Soil Mechanics and Foundations. W. L. Sagar.

Course 1a, IV Year; 2 hrs. lectures per week, both terms.

An introduction to the physical and mechanical properties of soil that govern its behaviour as an engineering material. The studies include sub-soil exploration, soil classification, moisture-density relations, shear strength, permeability, consolidation, frost action, and soil structure.

The foundation section deals with earth pressures and stress distribution in soils, bearing capacities, stability of slopes, retaining walls, cofferdams and caissons, pile and other foundations.

Reference books: Foundation Engineering—Peck, Hanson, Thornburn. Introductory Soil Mechanics and Foundations—Sowers & Sowers. Basic Soils Engineering—Hough. Proceedings, International Conferences on Soil Mechanics.

41. Reinforced Concrete. M. W. Huggins.

Course 1, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The theory of design of reinforced concrete elements including the beam, the slab, the T-beam, the column and the girderless floor, is continued in this course.

In addition the course provides an introduction to the design of prestressed concrete.

The student is required in the drafting room to apply his knowledge to the design of simple structures.

Text book: Reinforced Concrete Fundamentals—Ferguson.

Reference books: Theory & Practice of Reinforced Concrete—Dunham. Reinforced Concrete Design—Sutherland and Reese.

42. Reinforced Concrete Problems. M. W. Huggins, R. A. Collins, A. C. Davidson, S. M. Uzumeri.

Problems supplementing lecture course 41 are worked out in the laboratory. Reports written outside the laboratory period are not accepted.

43. Structural Design. M. W. Huggins.

Course 1a, IV Year; 1 hr. lecture per week, both terms.

Consideration is given to the various types of industrial build-

ings and other structures, the conditions governing their choice, and the design and details of construction in different materials. Examples in design are worked out in the class and drafting rooms illustrating such points as: economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, wind loading, wind bracing, rigid frames, crane runways.

Reference books: Design of Steel Structures—Gaylord & Gaylord. Handbook of Building Construction—Hool and Johnson. Steel Mill Buildings—Ketchum. Structural Problems—Young and Morrison. Theory of Modern Steel Structures—Grinter.

44. Mechanics of Materials: Concrete. W. L. Sagar, C. E. Helwig, C. W. Dillane, K. Meipoom.

Course 1, III Year; 3 hrs. laboratory per week, first term.

The fundamentals in the making of concrete. The tests of Portland cement and aggregates for concrete and rock for road construction. A series of experiments to show the effect on the consistency and strength of concrete caused by variations of the ingredients. The design of mixes.

No laboratory report shall be written outside the assigned teaching hours.

Reference book: Design and Control of Concrete Mixtures—Portland Cement Assoc.

49. Soil Mechanics and Foundations. W. L. Sagar.

Course 1b, IV Year; 1 hr. lecture per week, both terms.

An abridgement of the work covered in subject 40.

50. Mechanics of Materials: Soils and Highway. W. L. Sagar, C. E. Helwig, F. A. De Lory, C. W. Dillane, J. D. Barber.

Course 1, IV Year; 3 hrs. laboratory per week, second term.

The testing of bituminous materials used in highway construction and the analysis of bituminous paving mixtures. An introduction to practical soil mechanics is provided by a series of experiments investigating the physical and mechanical characteristics of soils related to highway and foundation work.

No laboratory report shall be written outside the assigned teaching hours.

Reference books: Specifications—Department of Highways, Ontario. Specifications—A.S.T.M.; C.S.A.; A.A.S.H.O. Soil Testing for Engineers—Lambe.

51. Structural Engineering Problems. W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Course 1, III Year; 6 hrs. per week, both terms.

Problems supplementing the work covered in lecture course 28 are assigned and worked out in the drafting room.

52. Structural Engineering Problems. W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Course 3, IV Year; 3 hrs. per week, both terms. (Not given in 1960–61.)

Problems supplementing the work covered in lecture course 30 are assigned and worked out in the drafting room.

53. Structural Engineering Problems. W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Courses 2 and 4, III Year; 3 hrs. per week, second term.

Problems supplementing the work covered in lecture course 29 are assigned and worked out in the drafting room.

54. Structural Engineering Problems. W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Course 1a, IV Year; 3 hrs. per week, both terms.

Problems supplementing the work covered in the lecture course 43 are assigned and worked out in the drafting room.

APPLIED PHYSICS

70. Applied Physics. F. B. Friend.

Course 1, II Year; 2 hrs. lectures per week, first term.

Course 7, II Year; 2 hrs. lectures per week, second term.

Correlating the physical principles of light, heat, sound, and vibration with problems in engineering, emphasizing the importance of the analytical approach.

Reference books: College Physics—Perkins. Introduction to Physical Optics—Robertson.

71. Applied Physics Laboratory, F. B. Friend.

Course 1, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, second term.

Supplementing subject 70.

Two laboratory reports per term.

72. Optics. F. B. Friend.

Courses 8 and 9, II Year; 1 hr. lecture per week, both terms.

Light, geometrical and physical optics and optical instruments, photography and photo micrography.

Reference book: A Second Course in Light—A. E. E. McKenzie.

73. Optics Laboratory. F. B. Friend.

Courses 8 and 9, II Year; 3 hrs. laboratory per week, both terms.

A laboratory course supplementing subject 72.

Two laboratory reports per term.

75. Photogrammetry. K. B. Jackson, J. Vlcek.

Course 1, III Year; 3 hrs. laboratory per week, first term.

A laboratory course on the instruments, materials and methods involved in the applications of photography as a means of recording, identifying and measuring the objects photographed.

77. Photogrammetry. K. B. Jackson, J. Vlcek.

Course 1_b, IV Year; 1 hr. lecture per week, both terms.

Photographic optics, photographic materials and processes, photography applied to measurement. Terrestrial and aerial survey photography. Perspective, scale, tip and tilt, rectification. Planimetric mapping. Stereoscopy. Stereoscopic photographs and plotting instruments. Topographic mapping. Photo interpretation. The application of aerial photographs to mapping, to the survey of natural resources, and to planning and development.

78. Photogrammetry. K. B. Jackson, J. Vlcek.

Course 1_b, IV Year; 3 hrs. laboratory per week, both terms.

Supplementing subject 77.

Two laboratory reports per term.

82. Acoustics. V. L. Henderson.

Course 7, IV Year; 2 hrs. lectures per week, second term.

This subject deals with the properties of acoustical elements, particularly with their application in electrical sound systems.

Reference book: Elements of Acoustical Engineering—Olson.

83. Acoustics Laboratory. L. M. Steinberg.

Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Supplementing subject 82.

Three laboratory reports.

93. Illumination. Miss M. G. Currie, J. Chisvin.

Course 7, IV Year; 2 hrs. lecture per week, second term.

Illuminating Engineering dealing with the nature, measurement, and production of light and related radiations.

Theory of human vision; the design and application of lighting equipment for visual efficiency and comfort. Fundamentals of power supply.

94. Illumination Laboratory. Miss M. G. Currie, J. Chisvin.

Course 7, IV Year; 3 hrs. per week, second term.

Supplementing subject 93.

Three laboratory reports.

97. Acoustics. V. L. Henderson.

Course 5e, III Year; 2 hrs. lectures per week, first term.

Acoustics of electrical sound systems; including sound waves hearing, the mechanical-electrical-acoustical analogy, microphones, loud speakers, etc.

Reference book: Elements of Acoustical Engineering—Olson.

98. Acoustics Laboratory. L. M. Steinberg.

Course 5e, III Year; 1½ hrs. laboratory per week, first term.

Supplementing subject 97.

99. Vibration Engineering. V. L. Henderson.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

100. Vibration Laboratory. V. L. Henderson.

Course 5t, IV Year; 3 hrs. laboratory per week, both terms.

A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurements, and control of vibration in engineering problems.

Three laboratory reports per term.

ASSAYING, MINING AND ORE DRESSING

160. Assaying. W. A. M. Hewer.

Courses 2, 8, and 9, III Year; 1 hr. lecture per week, both terms.

Theory and practice of fire assaying. Emphasis is laid not only upon the principles of chemistry, metallurgy and sampling involved, but also upon the errors inherent in operators as well as in methods.

References: Manual of Fire Assaying—Fulton and Sharwood. Textbook of Fire Assaying—Bugbee. Fire Assaying—Shepherd and Dietrich. The Sampling and Assay of the Precious Metals—E. A. Smith.

161. Assaying Laboratory. W. A. M. Hewer.

Courses 2 and 9, III Year; 3 hrs. laboratory per week, both terms.

The determination of precious metals. Scorification, crucible and combination wet and dry methods of assaying ores both simple and complex; milling and metallurgical products including cyanide solutions, cyanide precipitates and gold bullion. Attention is also given to the sampling and assay of ores containing radio-active minerals.

162. Wet Analysis. W. A. M. Hewer.

Course 2, III Year; 3 hrs. laboratory per week, both terms.

Analysis of furnace products, base metal, and radioactive ores.

164. Assaying Laboratory. W. A. M. Hewer.

Course 8, III Year; 3 hrs. laboratory per week, first term.

The instruction in general is as described under subject 161, but omitting determinations on precious-metal bullions and radioactive minerals.

165. Mining. H. R. Rice, W. A. M. Hewer.

Courses 2 and 9, II Year; 1 hr. lecture and 2 hrs. laboratory per week, second term.

A combined lecture and laboratory course in the principles of mining and its unit processes. Emphasis is placed on the statistical approach to sampling calculations.

168. Mining. H. R. Rice.
Courses 2 and 9, III Year; 3 hrs. lectures per week, first term.
Methods of mine development by mine adits, shafts, drifts and crosscuts; stoping methods, loading, and underground transportation.

169. Mining Laboratory. H. R. Rice, S. E. Wolfe.
Course 2, III Year; 3 hrs. laboratory per week, both terms.
Special mining problems are given relating to sampling, diamond drilling, stope measurements, the factors affecting the behaviour of broken materials. To develop the individual student's initiative, some special survey problems are worked in the laboratory.

170. Mine Operation and Administration. H. R. Rice.
Courses 2 and 9, IV Year; 2 hrs. lectures per week, both terms.
Lectures on advanced mining practice, including mining methods, ground control, mine mechanization, mine services and plant, aspects of administration and finance, and industrial relations.

172. Mining Laboratory. H. R. Rice.
Course 2, IV Year; 2 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.
A problem which progresses from essential geological data, to a complete design of the related mine, which integrates the principles of mine economics, selection of mining rates, ore-reserve calculations, and plant design.

173. Mining Laboratory. H. R. Rice.
Course 9, IV Year; 3 hrs. laboratory per week, second term.
Problems in mine layout involving shaft location and size; mine development; choice of stoping methods, mining rate, and mine equipment; time and cost schedules; ore reserve calculations.

175. Mine Ventilation and Allied Problems. G. R. Lord, F. G. Ewens.
Course 2, IV Year; 2 hrs. lectures per week, first term.
Ventilation problems in Canadian mines, including the use of ventilation equipment, selection of fans, testing equipment, ventilation studies, the silicosis problem, fire control, etc.

176. Mine Ventilation Laboratory. The staffs in Mining and Mechanical Engineering.
Course 2, IV Year; 3 hrs. laboratory per week, first term.
Experiments in the laboratories and problems in the study room to give the student some practice in the use of ventilation test

equipment, and the solution of ventilation problems. An aggregate of about ten off-campus study hours may be required in preparation of some reports.

180. Mineral Dressing. S. E. Wolfe.

Courses 2 and 8, III Year; 2 hrs. lectures per week, both terms.

The course deals with the economics of, the theoretical principles and their practical application in, the treatment of ores and mineral aggregates. These involve the processes of crushing, grinding, sizing and classification; gravity, magnetic, and electrostatic separation; and an introduction to froth flotation. In addition, ancillary processes are studied. These include flocculation, sedimentation, filtration, drying of mineral products and the precipitation and collection of dust and fume.

181. Mineral Dressing Laboratory. S. E. Wolfe.

Course 8, III Year; 6 hrs. laboratory per week, second term.

The subject matter in general is as described under Subject 182, but with more emphasis on processes involving surface phenomena.

182. Mineral Dressing Laboratory. S. E. Wolfe.

Course 2, III Year; 6 hrs. laboratory per week, second term.

This work is coordinated with the lecture course 180. Studies are made of crushing machinery, the principles of crushing and grading of rock products, screen analysis, and the sampling of broken material and mill products. Certain tests with gravity concentrating machines are made and an introduction to the technique of flotation test work is given.

183. Ore Dressing. S. E. Wolfe.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The subjects covered are extensions of those in 180, 181, and 182; cyanidation, flotation processes and techniques, the current practice at milling plants, and problems associated with milling.

184. Ore Dressing Laboratory. S. E. Wolfe.

Course 2, IV Year; 6 continuous hours per week, first term.

Advanced work coordinated with lecture course 183 and pertaining to ore dressing appliances, the handling in bulk of finely divided solids, the selective flotation of sulphides, ore testing, and pilot plant mill runs.

186. Mineral Dressing. S. E. Wolfe.

Course 9, III Year; 2 hrs. lectures per week, first term.

This abridged course deals with current practice and fundamental principles in the field of mineral beneficiation.

192. Summer Essay. W. A. M. Hewer.

Course 2, III Year:

An essay, or report, written on a mining subject, preferably some phase of work with which the student is associated during

summer employment. Subsequently, each student will deliver a talk to his class on the subject chosen. Thus, training is afforded in both technical writing and public speaking. Students are briefed in advance concerning requirements of this course.

193. Oral Expression. Mrs. Helen Tucker.

Courses 2 and 9, II Year; 2 hrs. seminar per week, second term.

A seminar course in oral expression. The objective is to improve the ability to speak as a means of communication. Clear expression of sound thinking is discussed and practised in speech assignments.

ASTRONOMY AND GEODESY

No laboratory reports shall be written outside the assigned teaching hours.

200. Practical Astronomy. H. L. Macklin.

Course 1, II Year; 1 hr. lecture per week, both terms.

The derivation of formulae and their application to the solution of spherical triangles and practical problems. Practical determination of time, latitude and azimuth by methods adapted to the use of the surveyor's transit. The subject will be designed to enable the student to carry out these observations at the Summer Survey Camp.

Text books: Practical Astronomy—Nassau.

201. Control Surveys. O. J. Marshall.

Course 1, III Year; 1 hr. lecture per week, second term.

Principles and Methods of control surveys involving triangulation, traverse, and levelling of various degrees of precision; elementary geodesy and map projections.

Reference books: Higher Surveying—Breed and Hosmer, Vol. II, 8th Ed. Theory and Practice of Surveying—Tracy. Advanced Surveying and Mapping—Whitmore.

202. Astronomy. H. L. Macklin.

Course 1_b, IV Year; 1 hr. lecture per week, first term.

Precise determination of time, latitude, longitude and azimuth as applied to geodetic surveys.

203. Astronomy. H. L. Macklin.

Course 1_b, IV Year; 3 hrs. laboratory per week, first term.

Observations and problems to accompany subject 202.

204. Geodesy. O. J. Marshall.

Course 1_b, IV Year; 2 hrs. lectures per week, second term.

Geometry of the spheroid, geographic co-ordinates, common map projections with related co-ordinate systems.

205. Geodesy. O. J. Marshall.

Course 1_b, IV Year; 3 hrs. laboratory per week, second term Problems in geodetic computations.

CIVIL ENGINEERING

214. Sanitary Engineering. A. P. Bernhart.

Course 1, IV Year; 1 hr. lecture per week, first term; 2 hrs. per week lecture, second term.

Supply, purification and distribution of water. Sewer systems. Treatment of residential and industrial waste water. Protection of water resources.

215. Sanitary Engineering Laboratory. A. P. Bernhart.

Course 1, IV Year; 1½ hr. laboratory per week, first term; 3 hrs. laboratory per week, second term.

First term: Six inspection field trips to Water Purification and Sewage Treatment plants in the Toronto area.

Six reports.

Second term: Problems supplementing the work covered in the Lecture Course 214 are assigned and worked out in the drafting room.

No laboratory report shall be written outside the assigned teaching hours.

216. Municipal Planning, Administration and Transportation. H. L. Macklin, M. Hugo-Brunt, M. M. Davis.

Course 1, III and IV Years; 2 hrs. lecture per week, first term; 1 hr. lecture per week, second term.

Contemporary concepts in town and regional planning and their theoretical, practical and legal applications as applied in Canada.

Organization of municipal government, municipal finance, legislation governing municipal operation, role of the municipal engineer and private practitioner in public works, provisions of municipal services.

Urban and regional growth as affected by transportation, trends, demands, characteristics and capacities, co-ordination with land use and integration with other services.

217. Highway Engineering. M. M. Davis.

Course 1, IV Year; 1 hr. lecture per week, both terms.

Organization, administration, economics and planning of rural highways; highway materials and paving; principles of location, design, construction and maintenance.

Text book: Highway Engineering—Hewes and Oglesby.

Reference books: The Highway Improvement Act—Ontario Highway Standards and Specifications—Department of Highways of Ontario. Soil Mechanics for Road Engineers—D.S.I.R.—H. M. Printer. Policy on Geometric Design of Rural Highways—A.A.S.H.O.

218. Construction Management. M. G. Tallon.

Course 1, IV Year; 1 hr. lecture per week, first term.

A study of heavy and building construction, including job planning and organization, construction methods and equipment, superintendence, job records, labour relations and safety procedures.

219. Town and Regional Planning. M. Hugo-Brunt.

Course 1b, IV Year; 1 hr. lecture per week, first term.

Town Planning principles both past and present. The role of the planner, the plan, local legislation, the central area, the neighbourhood, subdivision, the suburb, open space and the region, housing, road layout, services, industry, commerce and special uses.

220. Town and Regional Planning. M. Hugo-Brunt.

Course 1b, IV Year; 3 hrs. practical work per week, first term.

Studio work including exercises in survey, research and analysis, subdivision layout, and urban analysis. These are related to subject 219.

CHEMISTRY AND CHEMICAL ENGINEERING

221. Chemistry. The Staff in Chemical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

Chemical theory, with industrial and engineering applications.

222. Chemical Laboratory. W. F. Graydon, J. Binkiewicz.

Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, I Year; 3 hrs. laboratory per week, both terms.

A laboratory course illustrating the fundamental laws of chemistry as dealt with in the lecture course, and providing an introduction to chemical analytical methods.

223. Chemistry. W. H. Burgess.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Introductory physical chemistry: the gas laws, chemical equilibria, elementary solution chemistry, thermochemistry. Problems dealing with industrial and engineering applications.

224. Chemistry. W. F. Graydon, O. W. Berg.

Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.

Calculations based on systems in equilibrium; examples from pH solubility, complex formation and phase equilibrium.

225. Chemistry. A. D. Allen.

Course 7, II Year; 2 hrs. lectures per week, first term.

Inorganic Chemistry, with emphasis on the fundamental particles, atomic structure, the nature of the chemical bond and the general chemistry of the metallic elements.

226. Engineering Chemistry. R. R. McLaughlin, and staff in Chemical Engineering.

Courses 1, 3, and 4, II Year; 2 hrs. lectures per week, first term.

Corrosion and water-treatment; introduction to organic chemistry.

227. Analytical Chemistry Laboratory. W. F. Graydon, O. W. Berg.

Courses 2 and 9, II Year; 6 hrs. laboratory per week, first term.

Volumetric and gravimetric analysis.

228. Analytical Chemistry Laboratory. F. E. Beamish.

Course 8, II Year; 4 hrs. laboratory per week, both terms.

Quantitative and qualitatve analysis.

229. Analytical Chemistry Laboratory. I. H. Spinner.

Course 6, II Year.

This course commences on the Wednesday following the first Monday in September, and continues until the opening of the Fall Term. All the working time will be spent on systematic quantitative inorganic analysis.

Text book: Textbook of Inorganic Analysis—Kolthoff and Sandell.

230. Industrial Chemistry. W. G. MacElhinney.

Course 6, II Year; 2 hrs. lectures per week, first term: 1 hr. lecture per week, second term.

Manufacture of acids, alkalis, and inorganic chemicals; water-treatment, corrosion, explosives.

231. Inorganic Chemistry. R. E. Jervis.

Courses 6 and 8, II Year; 1 hr. lecture per week, first term: 2 hrs. lectures per week, second term.

The constitution of matter and classification of the elements: systematic inorganic chemistry.

232. Analytical Chemistry. I. H. Spinner.

Course 6, II Year; 2 hrs. lectures per week, first term.

Equilibrium considerations in quantitative analysis.

233. Analytical Chemistry Laboratory. I. H. Spinner.

Course 6, II Year; 9 hrs. laboratory per week, first term.

A continuation of Subject 229.

234. Organic Chemistry. J. G. Breckenridge.

Course 6, II Year; 1 hr. lecture per week, first term: 2 hrs. lectures per week, second term.

An introductory course in organic chemistry, with emphasis on reaction conditions and yields, and the industrial significance of certain compounds and reactions.

Text book: Systematic Organic Chemistry—Muldoon and Blake.

235. Chemical Engineering Science Laboratory. I. H. Spinner.
Course 6, II Year; 12 hrs. laboratory per week, second term.
Experiments illustrating the kinetic and equilibrium principles of chemical engineering. Instruction is given in shop practice, glass-blowing, and mass and heat balance calculations.
One laboratory report per week.

236. Physical Chemistry. R. L. McIntosh.
Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.
Principles of Phase Rule; introduction to chemical thermodynamics and theory of solutions.
Text book: Principles of Phase Equilibria—Wetmore and LeRoy.

237. Inorganic Chemistry. A. D. Allen.
Course 5, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
General inorganic chemistry, stereochemistry, and related physical measurements.
Reference book: General and Inorganic Chemistry—Partington.

238. Physical Chemistry. R. W. Missen.
Course 5, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
A continuation of subject 223, including: chemical kinetics and diffusion, surface chemistry and catalysis.
Text book: Physical Chemistry—MacDougall.
Reference book: Chemical Engineering Kinetics—Smith.

239. Chemical Theory A. W. H. Burgess, W. F. Graydon, R. R. McLaughlin.
Course 6, III Year; 1 hr. lecture per week, both terms.
Chemical kinetics; principles of adsorption and colloid chemistry.

240. Chemical Theory B. W. H. Burgess, W. F. Graydon.
Courses 5c and 6, III Year; 2 hrs. lectures per week, both terms.
Chemical thermodynamics, introductory to subject 256.

241. Industrial Chemistry. W. G. MacElhinney, W. H. Rapson.
Course 6, III Year; 3 hrs. lectures per week, second term.
Chemical process industries, including petroleum, soap, sugar, pulp and paper, and fermentation industries. In preparation for this course, students will be expected to have read and to be thoroughly familiar with the following: Chemical Process Industries—Shreve: Chapters 29, 30, 31, 33, 34, 37.

242. Introduction to Mass and Heat Transfer. W. G. MacElhinney.
Course 6, III Year; 2 hrs. lectures per week, both terms; 3 hrs. laboratory per week, second term.

The fundamental theory and practice used in transfer operations in chemical engineering. Energy and mass transfer are considered in the study of the flow of fluids, fluidization of solids, heat transfer, and evaporation of solutions.

Text book: Unit Operations of Chemical Engineering—McCabe and Smith.

244. Organic Chemistry. J. G. Breckenridge.

Course 6, III Year; 2 hrs. lectures per week, both terms.

A continuation of subject 234, dealing mainly with aromatic compounds.

245. Organic Chemistry Laboratory. W. H. Rapson, Z. May.

Course 6, III Year; 9 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A laboratory course accompanying subject 244.

One laboratory report per week.

246. Electrochemistry. F. E. W. Wetmore.

Course 8, III Year; 2 hrs. lectures per week, first term.

Elementary electrochemistry.

247. Electrochemistry Laboratory. M. J. Dignam.

Course 8, III Year; 18 hrs., first term.

Quantitative measurements to accompany subject 246.

249. Chemical Laboratory. W. F. Graydon, Z. May.

Courses 5c and 6, III Year; 6 hrs. laboratory per week, both terms.

A laboratory course to accompany subject 240.

250. Organic Chemistry. J. G. Breckenridge, I. H. Spinner.

Course 5c, IV Year; 2 hrs. lectures per week, both terms.

A lecture course in organic chemistry, concluding with a section on the chemistry of high polymers.

251. Chemical Engineering Laboratory. A. I. Johnson, W. G. MacElhinney, R. W. Missen, D. Trass.

Course 6, IV Year; 10 hrs. laboratory per week, first term.

A laboratory course to accompany subjects 242, 253, and 254. Bench and pilot plant experiments are carried out to study a variety of unit operations such as fluidization, heat transfer, evaporation, filtration, distillation, extraction, and absorption. Modern control instruments are discussed and operated. Experimental work for subject 254 is undertaken as a part of this laboratory.

One laboratory report per week.

252. Chemical Engineering Laboratory. Staff in Chemical Engineering.

Course 5c, IV Year; 6 hrs. laboratory per week, first term; 9 hrs. per week, second term.

Experiments illustrating the principles encountered in subjects 256 and 261.

253. Mass Transfer Operations. A. I. Johnson.

Course 6, IV Year; 2 hrs. lectures per week, both terms.

The theory and practice of mass transfer operations in chemical engineering are discussed. Many problems in distillation, extraction, absorption, and other operations illustrate the course.

Text book: Mass Transfer Operations—R. E. Treybal.

254. Chemical Plant Design. Staff in Chemical Engineering.

Course 6, IV Year; 1 hr. lecture per week, first term: 3 hrs. laboratory per week, second term.

Process design data for a typical chemical synthesis are collected from pilot plant studies. A full scale unit is then designed to illustrate the practical use of heat and mass transfer, fluid-flow, and thermodynamic and kinetic principles studied in other courses. Due consideration is given to economic considerations in this work.

255. Applied Mathematics in Chemical Engineering. A. I. Johnson, R. W. Missen.

Course 6, IV Year; 3 hrs. laboratory per week, first term.

A laboratory subject to accompany subjects 242, 253, and 254. Selected chemical engineering problems, introducing the students to graphical methods, alignment charts, numerical methods, and the application of differential equations, are discussed.

Text book: Applied Mathematics in Chemical Engineering—Sherwood and Reed.

256. Chemical Engineering Thermodynamics and Kinetics. W. H. Burgess, W. F. Graydon.

Courses 5c and 6, IV Year; 2 hrs. lectures per week, both terms.

The application of thermodynamics and kinetics to problems in the field of chemical engineering.

257. Organic Chemistry. R. R. McLaughlin.

Course 6, IV Year; 1 hr. lecture per week, both terms.

The chemistry of natural and synthetic high-molecular-weight materials.

258. Organic Chemistry Laboratory. J. G. Breckenridge.

Course 5c, IV Year; 3 hrs. laboratory per week, first term.

A laboratory course to accompany subject 250.

261. Diffusion and Mass Transfer. A. I. Johnson.

Course 5c, IV Year; 2 hrs. lectures per week, both terms.

Fundamental concepts of molecular diffusion, and application to transfer through still fluids and fluids in streamline flow. Mass transfer resulting from turbulent flow. Consideration of the resistance to mass transfer at phase interfaces. Consideration of the principles underlying the analysis and operation of mass transfer equipment for gas-liquid, liquid-liquid, and solid-liquid operations.

Text book: Mass Transfer Operations—Treybal.

Reference books: Mathematics of Diffusion—Crank; Advances in Chemical Engineering, Vol. 1—Drew & Hoopes.

DESCRIPTIVE GEOMETRY, ENGINEERING PROBLEMS AND DRAWING

DESCRIPTIVE GEOMETRY

269. Descriptive Geometry. C. A. Wrenshall, H. R. Frizzle.

All courses, I Year; 1 hr. lecture per week, both terms.

These lectures deal with the principles of orthographic and oblique projection and their use in solving problems of straight lines, planes, and curved surfaces.

Text book: Descriptive Geometry—Watts and Rule.

272. Descriptive Geometry. C. A. Wrenshall.

Course 1, II Year; 2 hrs. lectures per week, first term.

A continuation of lecture course 269. Problems of curved surfaces, shades, shadows and perspective are discussed: also, an introduction is given to the principles of projection used in map making.

Text book: Descriptive Geometry—Watts and Rule.

ENGINEERING PROBLEMS AND DRAWING

The courses in Engineering Problems and Drawing consist primarily in the solving of problems by the student at the drafting table under the personal guidance of an instructor. The problems deal with the fundamental engineering studies—mathematics, applied mechanics, descriptive geometry, the plotting of surveys that have been made by the student in the field, theory of machines.

275. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle, A. W. Walker.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 9 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (analytical geometry and calculus.) Plotting of original surveys for courses 1, 2 and 9.

Text book: Engineering Drawing—French and Vierck, latest Edition.

276. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle.

Course 5, I Year; 6 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (algebra and geometry, and calculus).

Text book: Engineering Drawing—French and Vierck, latest Edition.

284. Engineering Problems and Drawing. C. A. Wrenshall, A. W. Walker.

Course 1, II Year; 10½ hrs. per week, first term; 6 hrs. per week, second term.

Problems in descriptive geometry—intersection of curved surfaces. Plotting of original surveys. Problems in mechanics of materials. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition.

286. Engineering Problems and Drawing. B. M. M. Carpendale, C. L. Proctor.

Course 3, II Year; 6 hrs. per week, both terms.

Problems in descriptive geometry—intersection of curved surfaces. Problems in mechanics of materials, theory of machines. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition. Elements of Calculus—Peterson.

287. Engineering Problems and Drawing. A. W. Walker.

Courses 2, 6 and 9, II Year; 3 hrs. per week, alternate weeks, both terms.

Problems in mathematics.

288. Engineering Problems and Drawing. B. M. M. Carpendale, C. L. Proctor.

Course 4, II Year; 6 hrs. per week, both terms.

Problems in descriptive geometry—intersection of curved surfaces. Problems in mechanics of materials. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition. Elements of Calculus—Peterson.

289. Engineering Problems and Drawing. C. A. Wrenshall, A. W. Walker.

Course 8, II Year; 3 hrs. per week, both terms.

Problems in descriptive geometry, mechanics of materials and mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition.

BUSINESS ADMINISTRATION, ECONOMICS, HISTORY AND LAW

306. Accounting. F. N. Beard.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Basic accounting principles and procedures, the preparation and interpretation of financial statements, cost accounting, and the use of accounting as a means of control.

310. Business. F. N. Beard.

Courses 1, 2, 3, 7 and 9, III Year; 1 hr. lecture per week, second term.

Elements of business organization and management with an introduction to the principles of control through accounting records and financial statements.

311. Economics, B. D. Bixley, D. G. Hartle, J. I. Macdonald, E. P. Neufeld.
All courses, II Year; 2 hrs. lectures per week, both terms.
An Introduction to the study of Economics with special reference to the problems of the Canadian economy.
Text book: An Introduction to Political Economy—Bladen.

314. Engineering Law. W. O. Chris. Miller.
Courses 1, 3, 4, 6, and 7, IV Year; 1 hr. lecture per week, first term.
A subject designed to co-ordinate the practice of engineering and law. Consideration is given to the characteristics, advantages and disadvantages of companies, partnerships and sole proprietorships, the promotion, organization and financing of companies, the duties of employees to employers, the duties and liabilities of engineers, statutes applicable to engineering works, professional engineering associations, construction contracts, workmen's compensation, trade unions and industrial disputes.
Text book: Engineering Law—Laidlaw and Young.

315. Industrial Management. B. M. M. Carpendale, D. J. Clough, P. B. Hughes.
Courses 3, 6, 7, IV Year; 1 hr. lecture per week, first term.
Introduction to principles of management, control methods, work measurement, wages and incentive.
Subjects 314 and 315 are combined in one examination.

319. Public Speaking. The Staff in Chemical Engineering.
Course 6, III Year; 1 hr. per week, both terms.

320. Industrial Management. T. C. Graham.
Course 4, IV Year; 2 hrs. lectures per week, both terms.
A study of the factors involved in the production and distribution of products or services. Consideration will be given to the general concepts of management, organization, leadership and industrial relations but major emphasis will be on work simplification, time and motion study, wage administration and controls of production, quality and costs.

322. Industrial Management Laboratory. T. C. Graham.
Course 4, IV Year; 3 hrs. laboratory per week, both terms.
Cases and problems to accompany the lecture subject.

323. Introduction to Political Science. W. E. Grasham, J. T. McLeod.
All courses, I Year; 1 hr. lecture per week, both terms.
An introduction to the study of government with special reference to the problems of Canadian government.

324. Europe and the Modern World, 1500-1950. R. A. Spencer, J. C. Cairns.

All courses, III Year; 2 hrs. lectures per week, both terms.

An introduction to the main currents of European history between 1500 and 1950, and of European relations with the extra-European world. The purpose of the course is not the accumulation of factual information but the attainment of some understanding of historical processes, affecting the forms of political organization, economic activity, intellectual and social movements.

326. Philosophy of Science. Marcus Long, C. W. Webb.

Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, IV Year; 2 hrs. lectures per week, first term.

The relation between Science and Philosophy; an examination of the presuppositions of science and its basic concepts; alternative accounts of the nature of the universe with their implications for social and moral behaviour.

327. Industrial Psychology. W. Line.

Course 4, III Year; 2 hrs. lectures per week, second term.

A series of lectures and discussions on human relations, with the focus on some of the current problems in a developing industrial culture.

ELECTRICAL ENGINEERING

330. Electricity. Staff in Electrical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism, including Kirchhoff's Laws and network theorems as applied to direct-current circuits, induced voltages, self and mutual inductance and an introduction to electric field concepts. The MKS system of units is used.

Text book: Introduction to Electrical Engineering—Ward.

331. Electricity. Staff in Electrical Engineering.

Course 5, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism that is similar to subject 330 but adapted to the needs of Course 5.

332. Electric Circuits I. I. R. Dalton.

Course 7, II Year; 3 hrs. lectures per week both terms; 2 hrs. computation, alternate weeks, both terms.

The relation of lumped parameters to field concepts, their physical realization and their variation with frequency. The representation of simple systems by lumped parameter circuits.

The analysis of linear circuits in the steady state with either direct or alternating sources. Loop and nodal methods. The elements of the topography of circuits. Coupled circuits. Response of circuits to variable frequency.

The transient response of simple linear circuits to suddenly applied sources and its relation to the steady state.

Three-phase circuits, balanced and unbalanced. Other polyphase circuits.

General network theorems, rigorously derived, including the transformation theorems.

333. Electric and Magnetic Fields, J. E. Reid.

Course 7, II Year; 2 hrs. lectures per week, both terms; 2 hrs. computation, alternate weeks, both terms.

Electric and magnetic fields, forces and energies associated with charged and current-carrying conductors embedded in dielectric and magnetic media. Particle dynamics in electric and magnetic fields. Time-varying fields in conductors and insulators. Development of Maxwell's equations and interpretation in static and dynamic situations.

334. Electrical Laboratory and Problems.

Courses 3 and 4, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 6 hrs. laboratory per week, second term.

Appropriate laboratory experiments to accompany subjects 332, 338, and 340.

Courses 3 and 4. Six laboratory reports.

Course 7. Ten laboratory reports.

335. Electrical Problems and Seminar.

Course 7, III Year; 2 hrs. per week, first term; 4 hrs. per week, second term.

Problems associated with courses 336, 337, 339 and 341 are worked out under staff supervision. To provide practice in public speaking, one hour per week in the second term is devoted to short talks and discussions by the students on topics of their own choice.

336. Mathematical Applications in Electrical Engineering. A. J. Kravetz.

Course 7, III Year; 2 hrs. lectures per week, both terms.

This course is intended to develop certain topics in mathematics such as complex numbers and functions, numerical analysis, differential equations, Laplace transformation and vector analysis and apply them to problems of electrical engineering.

Reference books: Mathematical Methods in Electrical Engineering—Reed and Reed. Advanced Mathematics for Engineers—Reddick and Miller. Differential Equations—Piaggio.

337. Electronics. S. Dmitrevsky.

Course 7, III Year; 2 hrs. lectures per week, both terms.

The behaviour of electrons in electric and magnetic fields, thermionic emission, semiconductors, vacuum-tube and transistor characteristics and circuit models, simple vacuum-tube and transistor circuits.

338. Electricity. H. A. Courtice.

Courses 3 and 4, II Year; 2 hrs. lectures per week, first term.

General principles and calculations of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power, and energy. The principles underlying commercial instruments are considered, together with the methods of calibration.

Reference books: Electrical Measurements—Laws. Basic Electrical Measurements—Stout.

339. Direct Current Machines. G. R. Slemon.

Course 7, III Year; 2 hrs. lectures per week, first term.

The theory and operation of direct current machines. Methods of calculating the operating characteristics of generators and motors are presented and illustrated by the use of problems.

Reference books: Direct-Current Machinery—Kloeffler, Brenneman, and Kerchner. Principles of D.C. Machines—Langsdorf.

340. Electrical Measurements. H. A. Courtice.

Course 7, II Year; 2 hrs. lectures per week, second term.

Measurement of electrical quantities such as charge, potential difference, current, magnetic flux, energy and power. Measurement of electrical properties such as dielectric constant, permeability and conductivity. Measurement of resistance inductance and capacitance. Transducers for electrical measurement of mechanical, thermal and other physical quantities. Measurement of alternating-current quantities in single phase and polyphase systems. Accuracy of measurement, curve fitting and treatment of measured data.

341. Alternating-Current Circuits II. J. E. Reid.

Course 7, III Year; 2 hrs. lectures per week, both terms.

Polyphase circuits. Circuits with non-sinusoidal waves. Fourier series. Theory of coupled circuits and the transformer. Measurements.

Reference books: Alternating-Current Circuits—Kerchner and Corcoran. Alternating-Current Circuits—Tang.

342. Electric Machines. P. E. Burke.

Course 4, IV Year; 2 hrs. lectures per week, first term.

Operating characteristics and applications of transformers and rotating electric machines.

343. Electric Machines Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, first term.

Laboratory exercises to accompany subject 342.

Four laboratory reports.

344. Electrical Laboratory.

Course 7, III Year; 3 hrs. laboratory per week, both terms.

This laboratory course accompanies lecture courses 339 and 341. It consists of three groups of experiments dealing respectively with direct current machinery, fundamental properties of single-phase and three-phase alternating-current circuits and the single-phase transformer.

Eight laboratory reports.

345. Electronics. J. L. Yen, I. R. Dalton.

Courses 3 and 4, III Year; 2 hrs. lectures per week, first term.

Thermionic emission, vacuum-tube characteristics and applications, gaseous-tube characteristics and applications, control systems.

Text book: Introduction to Industrial Electronics—Benedict.

346. Electronics Laboratory.

Courses 3 and 4, III Year; 3 hrs. laboratory alternate weeks, first term.

Laboratory exercise to accompany subject 345.

Four laboratory reports.

347. Electric Circuits and Machines. I. McCausland.

Courses 1 and 2, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Principles of alternating-current circuits, impedances in series and parallel, three-phase circuits. Power measurement in single-phase and three-phase circuits. Direct-current motors and generators. Transformers, induction motors and synchronous machines. Introduction to electronics.

Text book: Electrical Engineering, Theory and Practice—Erickson and Bryant.

348. Electrical Laboratory.

Courses 1 and 2, II Year; 3 hrs. laboratory alternate weeks, second term.

Introductory laboratory practice in methods of measuring electrical quantities. Experiments on alternating-current circuits, the transformer and the polyphase induction motor.

Three laboratory reports.

350. Circuit Analysis. V. G. Smith.

Course 5e, IV Year; 2 hrs. lectures per week, both terms.

Advanced analytical methods are used to derive general net-

work theorems and to discuss general network properties. Complex wave forms, filters and unbalanced polyphase networks are considered in detail.

Reference books: Alternating-Current Circuits—Kerchner and Corcoran. Alternating-Current Bridge Methods—Hague. Symmetrical Components—Wagner and Evans.

351. Circuit Analysis. V. G. Smith.

Course 7, IV Year; 2 hrs. lectures per week, first term; 3 hrs. lectures per week, second term.

Advanced analytical methods are used to derive general network theorems and to discuss general network properties. Electric wave filters and unbalanced power networks receive detailed consideration.

Reference books: Same as for subject 350.

352. Transmission at Low and High Frequencies. G. Sinclair.

Course 7, IV Year; 3 hrs. lectures per week, first term.

The propagation of waves on transmission lines, under transient and steady-state conditions.

353. Alternating Current Machinery I. G. F. Tracy.

Course 7, IV Year; 3 hrs. lectures per week, first term.

The theory and performance of generators, synchronous motors, single and polyphase induction motors.

Reference books: Principles of Alternating Current Machinery—Lawrence. Alternating Current Machines—Puchstein and Lloyd.

354. Electric Circuits. G. R. Slemon, P. E. Burke.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Circuits as models for physical devices. Kirchhoff's laws and network topology. Network theorems. Complex algebra in alternating-current circuit analysis. Applications to single and polyphase power circuits, instruments, transformers, electronic circuits.

355. Electrical Laboratory.

Course 7, IV Year; 3 hrs. laboratory per week, first term; 1½ hrs. laboratory per week, second term.

Studies of principles and properties of single-phase and polyphase circuits and apparatus. Vector and analytical methods are applied to the solution of problems related to the characteristics of transformers, alternators, synchronous motors, converters, induction motors, transmission lines, and other alternating current equipment.

Seven laboratory reports.

Reference books: Electrical Engineering—Christie. Experimental Electrical Engineering, Vols. I and II—Karapetoff. Principles of A.C. Machinery—Lawrence. A.C. Machinery—Bryant and Johnson. Principles of Alternating Current Machinery—Langsdorf.

356. Electric Circuits Laboratory.

Course 5, II Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory exercises to accompany subject 354.

Ten laboratory reports.

357. Electric Control Systems. J. M. Ham.

Courses 5e, 5n and 7, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Application of circuit analysis and differential equations to problems of energy control by electronic and electro-mechanical means. Rectification and inversion with switching devices. Power modulators—switching amplifiers (electronic and magnetic), rotary electromagnetic amplifiers. Characteristics of loads—torques, resistance welding, electromagnetic heating, etc. Control "systems"—purposes and applications of feedback. Computation and simulation in system design.

358. Electric Control Systems Laboratory.

Courses 5e, 5n and 7, IV Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory experiments and design problem periods to accompany subject 357.

Four laboratory reports.

359. Electrical Problems and Seminar.

Course 7, IV Year; 2 hrs. per week, both terms.

Oral presentation by each fourth year student of his thesis, together with discussions by other members of the group.

360. Communications I. J. E. Reid.

Courses 5e, 5s, 5m and 7, IV Year; 3 hrs. lectures per week, first term.

The basic principles of amplification, detection, modulation, demodulation, and radio-frequency power generation.

Reference book: Applied Electronics—Gray.

361. Communications Laboratory.

Courses 5e, 5s, 5m and 7, IV Year; 3 hrs. laboratory per week, first term.

Experiments and problems to accompany subject 360.

Six laboratory reports.

362. Communications II. J. E. Reid.

Courses 5e and 7, IV Year; 3 hrs. lectures per week, second term.

A continuation of subject 360 covering theory and design of Class B and C amplifiers, power oscillators, crystal oscillators. Noise in communication circuits. Frequency conversion. Impedance transformation.

Reference book: Applied Electronics—Gray.

363. Communications Laboratory.

Courses 5e and 7, IV Year; 3 hrs. laboratory per week, second term.

Experiments and problems to accompany subjects 362 and 371.

Seven laboratory reports.

364. Operational Methods. V. G. Smith.

Courses 5e, 5m, 5n, 5s and 5t, IV Year; 2 hrs. lectures per week, both terms.

Classical and Heaviside's operational methods are developed. Fourier's methods leading to the Laplace transforms are discussed and the close relationship between Laplace and Heaviside emphasized. Applications are chiefly to electric circuit analysis.

Reference books: Transformation Calculus and Electric Transients—Goldman. Electromagnetic Theory—Heaviside. Transients in Linear Systems—Gardner and Barnes. Simple Calculation of Electrical Transients—Carter.

365. Applied Electromagnetic Theory. G. Sinclair.

Courses 5e, 5g, 5m, 5n and 5s, IV Year; 2 hrs. lectures per week, both terms.

Electrostatics is reviewed and developed further to compute the capacities of engineering structures. Electromagnetism is reviewed and Maxwell's equations obtained. These are then applied in a study of plane waves, wave guides and antenna radiation.

Reference book: Electromagnetic Waves and Radiating Systems —Jordan.

366. Electronics. S. Dmitrevsky.

Course 5, III Year; 2 hrs. lectures per week, both terms.

Basic theory of the behaviour of electrons in electric and magnetic fields, thermionic emission, transistor and electron-tube characteristics, circuit models and applications, conduction through gases.

Reference book: Applied Electronics—T. S. Gray.

367. Alternating-Current Circuits. J. L. Yen, I. R. Dalton.

Courses 3 and 4, II Year; 2 hrs. lectures per week, second term.

Fundamentals of alternating current, voltage and power. The analysis of series, parallel and three-phase circuits containing resistance, inductance and capacitance.

368. Alternating-Current Circuit Laboratory.

Courses 3 and 4, II Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 367.

Three laboratory reports.

369. Alternating Current Machinery II. G. F. Tracy.
Course 7, IV Year; 2 hrs. lectures per week, second term.
A continuation of subject 353. Special types of alternating current motors, synchronous converters, single-phase induction motors, frequency changes, selsyn devices.

370. Alternating Current Machinery Laboratory.
Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.
Laboratory exercises to accompany subject 369.
Three laboratory reports.

371. Communications III. G. Sinclair.
Courses 5e and 7, IV Year; 2 hrs. lectures per week, second term.
Transmission lines at ultra-high frequencies, generation and amplification at high frequencies, semi-conductor devices at low frequencies.

373. Electric Power Systems. G. R. Slemon.
Course 7, IV Year; 2 hrs. lectures and 2 hrs. computation per week, second term.
The theory associated with the economic generation, transmission and distribution of electrical energy in bulk and the control of power systems under normal and fault conditions.

375. Electrical Engineering. A. Straughen.
Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.
Principles of d-c and a-c circuits including the more important methods of measuring resistance, current, potential difference, power and energy; the principles of operation of d-c and a-c machinery; thermionic tube characteristics and applications.
Text book: Basic Electrical Engineering—Fitzgerald and Higginbotham.

376. Electrical Engineering Laboratory.
Courses 6 and 8, II Year; 3 hrs. laboratory per week, both terms.
Laboratory exercise to accompany subject 375.
Ten laboratory reports.

377. Electric Machines. A. J. Kravetz.
Courses 3 and 5e, III Year; 2 hrs. lectures per week, both terms.
Operating characteristics, control, and applications of direct-current and alternating-current machines.

378. Electric Machines Laboratory.
Courses 3 and 5e, III Year; 3 hrs. laboratory alternate weeks, first term; 3 hrs. laboratory per week, second term.
Laboratory exercises to accompany subject 377.
Seven laboratory reports.

379. Electronics Laboratory.

Courses 5 and 7, III Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subjects 337 and 366.

Three laboratory reports.

GEOLOGICAL SCIENCES

380. Physical Geology. P. A. Peach.

Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.

An introduction to the study of geology and mineralogy.

Reference books: Princinples of Physical Geology—Holmes. Principles of Geology—Gilluly, Waters and Woodford *or* Physical Geology—Leet and Judson.

381. Physical Geology Laboratory.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. laboratory and 1 hr. tutorial per week, first term.

A laboratory course to accompany subject 380.

382. Engineering Geology. W. H. Gross.

Courses 1 and 5g, III Year; 2 hrs. lecture per week, both terms.

An introduction course in geology with special reference to engineering problems.

383. Engineering Geology Laboratory.

Course 1, III Year; 2 hrs. per week, both terms.

Specimens, maps, and sections to accompany subject 382.

384. Glacial Geology and Ground Water. R. E. Deane.

Courses 2 and 5g, IV Year; 1 hr. lecture per week, both terms.

Pleistocene Geology. The formation and distribution of the drift deposits of North America, with emphasis on their economic importance.

385. Elementary Geochemistry. F. G. Smith.

Course 9, III Year; 2 hrs. lecture per week, both terms.

Covering the periodic table, distribution of the elements, states of matter, phase diagrams, natural hydrothermal solutions, weathering, and geochemical cycles.

386. Mineralogy and Lithology. D. H. Gorman, P. A. Peach.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. lecture per week, both terms.

A study of crystallography, descriptive and determinative mineralogy, and the common rocks.

Reference book: An Introduction to the Study of Minerals—Rogers.

387. Mineralogy and Lithology Laboratory. D. H. Gorman, P. A. Peach.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. per week, both terms.

Practice in identifying minerals and rocks.

388. Descriptive Mineralogy. D. H. Gorman.
Course 9, III Year; 2 hrs. laboratory per week, both terms.
Continuation of the mineralogy of subject 386.

389. Ore Microscopy. D. H. Gorman.
Course 9, III Year; 3 hrs. laboratory per week, second term.
Identification of minerals in polished sections.

390. Crystallography. E. W. Nuffield.
Courses 5m, 5s and 8, III Year; 1 hr. lecture per week, both terms.
The modern concept of crystals; symmetry elements; derivation of space lattices, classes, forms, indices.

391. Petrology. P. A. Peach.
Course 9, III Year; 3 hrs. lecture per week, first term; 2 hrs. lecture per week, second term.
Microscopic character of the rock-forming minerals in thin sections, and description and classification of rocks.
Text books: Optical Crystallography—Wahlstrom. Eruptive Rocks—Strand.

392. Petrography Laboratory. P. A. Peach.
Course 9, III Year; 2 hrs. per week, both terms.
Microscopic petrography, to accompany subject 391.
Text book: Optical Mineralogy—Rogers and Kerr.

393. Historical and Stratigraphical Geology. F. W. Beales.
Courses 2 and 9, II Year; 2 hrs. lectures and 1 hr. tutorial per week, second term.
Study of the principles of stratigraphy and historical geology since Precambrian times.

394. Historical and Stratigraphical Geology Laboratory. F. W. Beales.
Course 9, II Year; 2 hrs. per week, second term.
Laboratory work to illustrate subject 393.

395. Palaeontology. M. A. Fritz.
Course 9, III Year; 2 hrs. lecture per week, both terms.

396. Palaeontology Laboratory. M. A. Fritz.
Course 9, III Year; 2 hrs. per week, both terms.

397. Structural Geology. W. M. Tovell.
Courses 2, 5g and 9, III Year; 1 hr. lecture per week, both terms.
Structures caused by the deformation of the earth's crust.
Text book: Structural Geology—Billings.

398. Structural Geology Laboratory. W. M. Tovell.
Courses 2, 5g and 9, III Year; 3 hrs. per week, both terms.
Work with geological maps of folded and faulted areas, structural sections, and the solution of problems relating to folding and faulting.
Laboratory course to accompany subject 397.

399. Mineral Deposits. W. H. Gross.
Courses 2, 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
Theories of origin of mineral deposits and description of world's important mineral deposits.

400. Mineral Deposits Laboratory. W. H. Gross.
Course 9, IV Year; 3 hrs. per week, second term.

401. Geology of Canada. F. W. Beales.
Course 9, IV Year; 1 hr. lecture per week, both terms.
A survey of the physiography, historical geology, major structural features, and mineral deposits of the country.

402. Pleistocene Geology. R. E. Deane.
Course 9, IV Year; 2 hrs. lecture per week, both terms.
Study of the Pleistocene Deposits of North America and Europe.

403. Precambrian Geology. W. W. Moorhouse.
Courses 2 and 9, IV Year; 2 hrs. lecture per week, first term.
Precambrian formations of Canada—their rocks, distribution, relationships and economic features.

404. Precambrian Geology Laboratory. W. W. Moorhouse.
Course 2, IV Year; 1 hr. laboratory per week, first term.
Course 9, IV Year; 3 hrs. laboratory per week, both terms.
To accompany subject 403.

405. Mining Geology. G. B. Langford.
Courses 2 and 9, IV Year; 2 hrs. lecture per week, second term.
A course dealing with the application of geology to mining.
Reference book: Mining Geology—McKinstry.

406. Mining Geology Laboratory. G. B. Langford.
Course 9, IV Year; 3 hrs. per week, first term.

407. Petroleum Geology. W. M. Tovell.
Courses 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
The origin, nature, and occurrence of petroleum and natural gas deposits and the extraction of these substances from the earth.

408. Petroleum Geology Laboratory. W. M. Tovell.
Courses 5g and 9, IV Year; 3 hrs. per week, second term.
Accompanying subject 407.

409. Stratigraphy and Sedimentation. F. W. Beales.
Course 9, III Year; 2 hrs. lectures per week, second term.
Description, classification and interpretation of sedimentary rocks and rock units.

410. Stratigraphic and Sedimentary Field Work. F. W. Beales.
Course 9, III Year; 2 hrs. per week, second term.
Field work along the Niagara Escarpment.

411. Geological and Mineralogical Field Work.
Courses 2 and 9, III Year; 7 days.
A field trip following the April examination to the Bancroft and Madoc areas of Ontario.

412. Geological Field Trips (Glacial Geology).
Courses 2 and 9, IV Year. Three ½ day trips.
During October weekly trips will be made to points of interest near Toronto.

413. Geological Field Trips (Petroleum).
Course 9, IV Year. 2½ days.
Oil and gas fields in Chatham area.

414. Geological Field Trips (Economic and Mining).
Course 9, IV Year. Two trips, each ½ day.
Trip to gypsum mine and cement plant.

415. X-Ray Crystallography. E. W. Nuffield.
Course 5m, IV Year; 2 hrs. lectures per week, second term.
X-ray diffraction methods and their application in the study of crystalline materials.

HEAT ENGINES

No laboratory reports to be written outside of assigned teaching hours.

420. Elementary Heat Engines. P. B. Hughes.
Course 3, II Year; 2 hrs. lecture per week, second term.
The history and development of heat engines, the principles upon which they operate, and the characteristic features of the different kinds of engines used in practice. The First and the Second laws of thermodynamics.
Text book: Elements of Thermodynamics and Heat Transfer—Obert.
Reference books: Thermodynamics of Heat Power—Faires. Steam, Air and Gas Power—Severns, Degler and Miles.

421. Theory of Heat Engines. R. C. Wiren, F. C. Hooper.
Courses 3 and 7, III Year; 2 hrs. lectures per week, both terms.
For each course selected topics are arranged to complement parts of the subject given in the Second and in the Fourth Years, with due emphasis on the material particularly desirable for each course.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles used in practice for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer. Regeneration.

Text book (Course 3): Elements of Thermodynamics and Heat Transfer—Obert.

Text book (Course 7): Basic Thermodynamics—Brown.

Reference books (All Courses): Thermodynamics of Heat Power—Faires. Thermodynamics—Lee and Sears. Steam, Air and Gas Power—Severns, Degler and Miles.

422. Heat Engineering. R. C. Wiren, W. A. Wallace, F. C. Hooper, S. Sandler.

Course 3, III Year; 2 hrs. lecture per week, first term; 1 hr. lecture per week, second term.

Course 5t, III Year; 2 hrs. lectures per week, both terms.

Steam Generators and Plant. Combustion calculations; analysis of fuels and products of combustion; boiler tests and heat balance; principles of design of boilers, furnaces, stokers, pulverised fuel, oil and gas firing equipment, economizers, air heaters, superheaters, feedwater heaters.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, McNaughton, Zerban and Nye.

Internal Combustion Engines. Types and operation; performance and testing; basic characteristics and principles of design; carburation; fuel injection; governing.

Text book: Internal Combustion Engines—Obert.

Reference books: Internal Combustion Engines — Polson, Maleev, Fraas.

Heat Transfer and Air Conditioning. Conduction, convection, radiation, and combined mechanisms of heat transfer. Air and water vapour mixtures, requirements for comfort and industrial processes; the use of psychrometric charts; heating, cooling, humidifying and dehumidifying processes; calculation of air conditioning loads; air conditioning systems and equipment.

Reference book: Heating and Air Conditioning—Allen, Walker and James.

423. Heat Engineering Laboratories. R. C. Wiren, W. A. Wallace, F. C. Hooper, R. W. P. Anderson, W. J. Moroz, C. H. Miller.

Courses 3 and 5t, III Year; 1 three-hour laboratory period per week, both terms.

Course 7, III Year; 1 three-hour laboratory period per week, first term.

Courses 4 and 6, III Year; 1 three-hour laboratory period per week, second term.

The laboratory work is designed to assist in clearer understanding of theory and practical applications, and consists of selected experiments in four laboratories: Heat Engine laboratory, Fuel Testing laboratory, Heat Transfer laboratory, Refrigeration and Air Conditioning laboratory.

The work on Heat Engines deals with the timing of engines, measuring indicated and brake horse-power, the use of power plant instruments, testing of air compressors, steam engines, steam turbines, internal combustion engines and gas turbines under various conditions, steam calorimetry and the solution of practical problems on steam plants, internal combustion engines, and gas turbines.

The Fuel Testing includes analysis of fuels and products of combustion, knock rating of gasolines, fuel calorimetry, etc.

The work on Heat Transfer deals with temperature measurement, tests on insulation and heat exchangers of various kinds.

The work on air conditioning deals with the use of instruments and charts, air conditioning standards, the solution of practical problem, and testing of air conditioning equipment.

424. Heat Power Engineering. R. C. Wiren.

Course 3, IV Year; 2 hrs. lecture per week, both terms.

A continuation of lecture course 422. Evaporators and miscellaneous heat exchangers. Condensers and auxiliary power plant equipment. Theory and design of turbines. Power plant cycles including reciprocating engines and turbines. Cycles for high pressures and temperatures. Superheating, reheating, regenerative and binary-fluid cycles. Steam generators employing forced circulation, indirect evaporation and pressure combustion. Power plant heat balance and efficiencies. Design of power plant equipment. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Heat and Thermodynamics—Zemansky. Engineering Thermodynamics—Obert, Young, Lee and Sears, Everett, Keenan, Ebaugh, Hawkins. Steam Power Plants—Gaffert, MacNaughton, Zerban and Nye. Steam Turbines—Church, Salisbury, Lee, Shepheard.

425. Internal Combustion. W. A. Wallace.

Courses 3 and 5t, IV Year; 1 hr. lecture per week, both terms.

The various types of internal combustion engine and their respective applications. The different cycles of operation and the avoidable and unavoidable losses. The admission, compression, combustion, expansion and exhaust operations, the factors that influence them and their application to the engine and turbine. The cooling system and its effect on thermal and mechanical conditions.

Reference book: Internal Combustion Engines—Obert.

426. Heat Engineering Laboratories. R. C. Wiren, W. A. Wallace, F. C. Hooper, R. W. P. Anderson, C. H. Miller.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 5 hrs. laboratory per week, second term.

Course 5t, IV Year; 3 hrs. laboratory work per week, both terms.

A continuation and extension of the work covered in the III Year laboratory subjects consisting of selected experiments in four laboratories: Heat Engine laboratory, Fuel Testing laboratory, Heat Transfer laboratory, Refrigeration and Air Conditioning laboratory.

In the Heat Engine laboratory complete tests are made of various engines such as simple, compound and uniflow steam engines, impulse and reaction type steam turbines, gas, oil and gasoline engines. In each case an analysis is made of the thermal cycle involved, a complete set of experiments is performed and the results plotted to show clearly to the student the effect of various alterations in adjustment on the results obtained. A complete boiler test is performed and all calculations are made for a heat balance. An analysis is made of cycles used in gas turbines and jets and a complete test is performed on a gas turbine plant. Problems involving variable specific heat are studied.

In the Fuel Testing laboratory the octane rating of gasoline samples is determined by A.S.T.M. methods and fuel injection spray characteristics are studied with special test equipment.

In the Heat Transfer laboratory tests are made on heat exchangers.

In the Air Conditioning and Refrigeration laboratory tests are performed on complete air conditioning systems, and complete refrigerating plants.

427. Theory of Heat Engines. R. C. Wiren.

Course 2, III Year; 1 hr. lecture per week, both terms.

Thermodynamics of gases and vapours as applied to engines, nozzles, turbines, compressors, heat exchangers, refrigeration plants, and air conditioning systems. Analysis of vapour and gas power cycles.

Text book: Basic Thermodynamics—Brown.

Reference books: Engineering Thermodynamics — Young, Ebaugh. Thermodynamics of Heat Power—Faires.

428. Heat Engine Laboratory. R. C. Wiren, W. A. Wallace, F. C. Hooper, R. W. P. Anderson, W. J. Moroz, C. H. Miller.

Course 2, III Year; 3 hrs. per week, second term.

Experiments with steam and internal combustion engines, compressed air, etc.

429. Refrigeration and Air Conditioning. F. C. Hooper.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

The thermodynamic cycles and processes of special interest in refrigeration are outlined and the properties of ideal and actual refrigerants examined. Basic psychrometric processes are reviewed and related to air conditioning system performance.

Text book: Theory of Mechanical Refrigeration—Sparks and Di Ilio.

Reference book: A.S.H.R.A.E. Guide.

430. Heat Power Engineering. R. C. Wiren.

Courses 5c and 5t, IV Year; 1 hr. lecture per week, both terms.

Application of Thermodynamics to the design of power plant equipment. Analysis of high pressure and high temperature vapour cycles. Superheating, reheating, regenerative and binary-fluid cycles. Steam generators employing forced circulation, indirect evaporation and pressure combustion. Steam turbines, power plant heat balance and efficiencies. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, Zerban and Nye, MacNaughton. Steam Turbines—Church, Salisbury, Lee. Engineering Thermodynamics—Obert, Young, Keenan, Hawkins.

431. Theory of Heat Engines. W. A. Wallace.

Course 6, III Year; 2 hrs. lecture per week, first term.

The theory and practice of heat engines, including a study of fundamental principles involved, an appraisal of theoretical developments, and a survey of the corresponding practical applications.

Text book: Thermodynamics of Heat Power—Faires.

432. Heat Transfer. C. H. Miller.

Course 8, IV Year; 2 hrs. lectures per week, second term.

Basic principles, definitions, units and dimensional analysis. Conduction in the steady and the unsteady states. The heat source within a conducting body. Free and forced convection. Condensing and boiling. Radiation. Combined effects of conduction, convection and radiation. Instrumentation and experimental methods.

Text book: Elements of Heat Transfer and Insulation—M. Jakob and G. A. Hawkins.

433. Heat Transfer. F. C. Hooper.

Courses 5_t and 5_n, IV Year; 1 hr. lecture per week, both terms.

Steady state and transient conduction, surface and gas radiation, convection, boiling, condensation and combined mechanisms are considered. Special attention is given to analogue and computational procedures and to consideration of the manner in which novel or complex problems may be approached.

Text book: Heat Transmission—McAdams.

434. Engineering Thermodynamics. R. C. Wiren, C. H. Miller.

Course 1, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The fundamentals of engineering thermodynamics. The First and Second Laws. Properties of substances. Heat transfer. Heat exchangers. Compressors, fans, pumps, reciprocating engines and turbines. Vapour and gas power cycles. Refrigeration. Air-conditioning.

Text book: Basic Thermodynamics—Brown.

Reference book: Engineering Thermodynamics—Ebaugh.

435. Theory of Heat Engines. P. B. Hughes.

Course 4, III Year; 2 hrs. lectures per week, second term.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles used in practice for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer.

HYDRAULICS AND FLUID MECHANICS

No laboratory reports to be written outside of assigned teaching hours.

440. Fluid Mechanics. G. R. Lord, L. E. Jones, C. L. Proctor, H. J. Leutheusser, J. F. Keffer.

Courses 1, 3, 4 and 7, III Year; 2 hrs. lectures per week, both terms.

Attention is given to the development and discussion of the fundamental principles of fluid flow. These principles are illustrated by suitable practical problems connected with fluid measurements, flow of fluids in pipes and open channels, with a brief discussion of the resistance of submerged bodies, dimensional analysis and similarity studies.

441. Fluid Mechanics Laboratory. G. R. Lord, L. E. Jones, C. L. Proctor, H. J. Leutheusser, J. F. Keffer.

Courses 1 and 3, III Year; one 3-hr. laboratory period per week, second term.

Courses 4 and 7, III Year; one 3-hr. laboratory period per week, first term.

This laboratory course is planned to illustrate the principles considered in the lecture courses in fluid mechanics. Experimental work in the laboratory utilizes a wide variety of apparatus and equipment concerned with fluid flow, while problems undertaken in the study room provide a link with general engineering practice.

443. Hydraulics. G. R. Lord.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

The general field of applied hydraulics and fluid mechanics is studied under the topics: hydrology; hydro-electric power plants and auxiliaries; conservation and flood control; canals, pipelines, etc., under both steady and unsteady conditions; hydraulic machinery, fans, compressors, turbines, pumps, etc., design, selection and operation; power and control circuits; flow of compressible fluids; similarity and model investigations; industrial applications.

444. Hydraulic Laboratory. G. R. Lord, L. E. Jones, J. F. Keffer.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

Experimental work is carried out in the laboratory on various types of pumps, turbines, fans, centrifugal compressors and on hydraulic models. In addition computation problems involving open channel flow, water power studies, pumps and turbine studies, water hammer phenomena, fans and ductwork, and other advanced flow problems are considered. General problems involving compressibility of gases are considered.

445. Hydraulic Engineering. L. E. Jones, W. D. Baines.

Course 1, IV Year; 2 hrs. lectures per week, both terms.

The general field of hydraulic engineering is studied under the topics: hydrology, flood control, dams, power plants, hydraulic machinery, water hammer, surges, irrigation, water supply and model studies.

446. Hydraulic Engineering Laboratory. G. R. Lord, L. E. Jones, W. D. Baines, H. J. Leutheusser.

Course 1, IV Year; one 1½-hr. laboratory period per week, first term; one 3-hr. laboratory period per week, second term.

Experimental studies of hydraulic models, turbines and pumps are carried out. Problems assigned in the study rooms deal with channel flow and other hydraulic features connected with water power installations, flood control, water supply and drainage systems.

449. Treatment of Technical Data. L. E. Jones.

Course 3, II Year; 2 hrs. lecture per week, second term.

Presentation of data; approximate nature of technical data; role played by mathematics; general numerical methods; methods of organizing data for computation; methods of analyzing technical data; elements of curve-fitting and statistical treatment.

452. Fluid Mechanics. L. E. Jones, H. J. Leutheusser.

Course 6, III Year; Courses 6 and 8, IV Year; 2 hrs. lecture per week, first term.

The fundamentals of fluid flow as generally encountered in industry. Fluid properties, fluid statics, energy relations, dimen-

sional analysis and dynamic similarity, flow in pipes and channels, resistance of submerged bodies, effects of viscosity and compressibility, lubrication, pumps and other hydraulic machines.

453. Fluid Mechanics Laboratory. G. R. Lord, L. E. Jones, H. J. Leutheusser.

Course 6, III Year; Course 6, IV Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit of correlating flow fundamentals with industrial applications.

454. Fluid Flow and Pumping Systems. L. E. Jones, H. J. Leutheusser, J. F. Keffer.

Course 2, III Year; 3 hrs. lectures per week, first term.

A discussion of the fundamental principles of fluid flow, with special attention to problems encountered in mining.

455. Fluid Flow and Pumping Systems Laboratory. G. R. Lord, L. E. Jones, H. J. Leutheusser, J. F. Keffer.

Course 2, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit correlation of flow fundamentals with mining applications.

MACHINERY

No laboratory reports written outside of assigned teaching hours.

461. Mechanical Engineering. W. G. McIntosh.

Course 3, II Year; 1 hr. lecture per week, first term.

Prior to registering in Second Year, the student is required to study the prescribed text, covering the topics of design materials and manufacturing methods and processes. The lecture work will involve discussion of the text matter, as well as new materials and processes. The final examination (in January) will cover both the prescribed study and the lecture work.

Text book: Manufacturing Processes (4th edition)—Begeman.

463. Mechanical Engineering. W. G. McIntosh, R. T. Waines.

Course 4, II Year; 2 hrs. lectures per week, both terms.

Materials of design and production methods. In addition, standards, tolerances, limits, fits and mechanical drafting room practice will be explained.

Text books: Manufacturing Processes—Begeman. Drawings and Drafting Room Practice. A.S.A.

464. Mechanical Engineering Laboratory. I. W. Smith, R. T. Waines.

Course 4, II Year; 3 hrs. laboratory per week, second term.

An introduction to the principles and techniques of fine measurement and instrumentation. Problems dealing with tolerances, force analysis, etc., will also be given.

465. Dynamics of Machines. I. W. Smith.

Course 3, II Year; 3 hrs. lectures per week, both terms.

Basic equations for accelerated motion of mass are developed

and applied to the analysis of machine elements. Velocity, acceleration, force distribution, speed fluctuation and balancing of machines are considered. Standard linkages, cams, gears, flywheels, governors and gyroscopes are given specific attention.

Text books: Engineering Dynamics—Hooper and Smith. Mechanisms and Dynamics of Machinery—Mabie and Ocvirk.

466. Dynamics of Machines Laboratory. I. W. Smith, R. T. Waines.

Course 3, II Year; 1½ hrs. laboratory per week, both terms.

The work in the laboratory will illustrate the principles covered in lecture subject 465.

467. Machine Design. I. W. Smith, D. L. Allen.

Courses 3 and 4, III Year; 2 hrs. lectures per week, both terms.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Faires.

468. Machine Design Laboratories. I. W. Smith, R. T. Waines, G. E. Godfrey.

Course 3, III Year; 4½ hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Course 7, III Year; 3 hrs. laboratory per week, second term.

Design laboratory work will be taken by students in all courses listed above. This will involve the design of machine elements with the object of illustrating the work covered in the lecture subjects in Machine Design. Sketching and drafting will be given with a view to developing the student's judgment and sense of proportion in design and the application of drafting room standards.

Mechanical laboratory work will be taken by Course 3. This will include selected experiments in speed measurement, oil testing, balancing, vibrations, testing of power drives, etc.

469. Machine Design. R. T. Waines.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The design and selection of machinery and equipment met with in metallurgical plants, and in mining work.

Text book: Design of Machine Elements—Faires.

470. Machine Design Laboratory. I. W. Smith, R. T. Waines.

Courses 2, 6 and 8, IV Year; 3 hrs. laboratory per week, second term.

Problems worked out in the laboratory, designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

471. Machine Design. J. VandeVegte.

Courses 5e, 5m, 5n, 5s, 5t, III Year; 1 hr. lecture per week, both terms.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Faires.

472. Machine Design Laboratory. I. W. Smith, R. T. Waines, J. VandeVegte.

Courses 5e, 5m, 5n, 5s, 5t, III Year; 3 hrs. laboratory per week, both terms.

The work in the laboratory will consist of the analytical solution of problems, illustrating the principles involved in the lecture course, and the standard practice in making assembly and detail machine drawings.

473. Machine Design. I. W. Smith.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

This is a continuation of subjects 467 and 466. It will involve the design of various machine elements and equipment including machine frames, hooks, hoisting equipment, crankshafts, gears (helical, herringbone, bevel, screw, and worm), springs, clutches, brakes, thin and thick wall vessels.

An introduction will be given to the study of vibration problems encountered in high speed engines and machines.

Text books: Machine Design—Shigley. Mechanical Vibrations —Thomson.

474. Machine Design Laboratories. I. W. Smith, R. T. Waines.

Course 3, IV Year; 5 hrs. laboratory per week, both terms.

Advanced laboratory work involves both analysis and design of machine elements, machine units, and complete machines. The selection of problems is made with a view to giving the student as broad a coverage as possible and providing experience in combining of elements to form a machine of smooth and harmonious design. Some of this work will involve special shafting problems including graphical solutions, critical speeds, and multiple supports.

Work will be given in the Mechanical Laboratory on gauging and fine measurements, experimental stress analysis, vibration, and bearing testing.

475. Machine Design. G. E. Godfrey.

Course 7, III Year; 2 hrs. lectures per week, second term.

Force analysis; mechanics; velocities, accelerations and inertia forces in machines; principles of stress analysis and the design of various machine elements, including shafting, bearings, belts,

gears, etc.; also an introduction to work on speed fluctuation, vibrations and balancing.

Text book: Design of Machine Elements—Faires.

476. Manufacturing Processes. B. M. M. Carpendale, D. J. Clough, P. B. Hughes.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

The design and control of manufacturing processes and systems.

477. Manufacturing Processes Laboratory. B. M. M. Carpendale, D. J. Clough, P. B. Hughes.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Laboratory based on subject 476.

478. Machine Design. J. VandeVegte.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

A series of lectures on design methods related to heat engines, including force analysis, speed fluctuation, flywheel design, governors, vibrations, high speed bearings, and thermal stress.

Reference books: Mechanics of Machinery—Ham and Crane. Analysis and Lubrication of Bearings—Shaw and Macks. Design of Machine Elements—Faires.

479. Machine Design. R. T. Waines.

Course 6, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The design of various machine elements, particularly those likely to be met with in chemical plants, and an outline of the properties, production methods, and selection of materials used in machine equipment.

Reference books: Process Equipment Design—Hesse and Rushton. Principles of Machine Design—Berard, Waters and Phelps. Design of Machine Elements—Faires.

480. Elementary Control Theory.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

System characteristics, including response, feedback and control; equivalence of functioning elements; sensing elements; criteria for selection.

481. Elementary Control Theory Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Problems and laboratory experiments related to subject 480 are dealt with.

MATHEMATICS

490. Calculus. G. F. D. Duff, R. Murphy, R. A. Ross, C. J. Scriba, D. W. H. Shale, F. A. Sherk, W. A. Skirrow, J. Vanstone.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

Derivation of the fundamental formulas of the differential and integral calculus, with applications to problems concerning curves, areas, volumes, lengths. Problems are dealt with in the drafting room as outlined in subject 275.

491. Calculus. A. F. Pillow, I. R. Pounder, G. deB. Robinson, P. G. Rooney, J. A. Steketee, M. Stephens.

Courses 1, 2, 3, 4, 6, 8 and 9, II Year; 2 hrs. lectures per week, both terms.

Continuation of subject 490. The elementary theory reviewed and extended, with special attention to applications in engineering. Introduction to simple differential equations. Problems are dealt with in the drafting room as outlined in subjects 284, 285, 286, 287, 288 and 289.

492. Analytical Geometry. G. F. D. Duff, R. Murphy, R. A. Ross, C. J. Scriba, D. W. H. Shale, F. A. Sherk, W. A. Skirrow, J. Vanstone.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 1 hr. lecture per week, both terms.

The Secondary School course in the geometry of the plane is extended and is followed for the greater part of the session by an algebraic treatment of the geometry of planes, lines, and quadric surfaces. Problems are dealt with in the drafting room as outlined in subject 275.

493. Calculus and Differential Equations. Staff in Mathematics.

Course 7, II Year; 2 hrs. lectures per week, both terms. 2 hrs. computation per week, both terms.

The definite integral, expansion in series, ordinary differential equations, partial differentiation, multiple integration and an introduction to partial differential equations.

494. Least Squares. O. J. Marshall, H. L. Macklin, B. J. Haynes.

Course 1, II Year; 3 hrs. laboratory per week, second term.

The general principles of probability of errors, elementary problems illustrating the application of Least Squares to the adjustment of observations, empirical constants and formulae.

No laboratory reports shall be written outside the assigned teaching hours.

Text books: Least Squares in Engineering—Marshall and Macklin.

495. Mathematical Problems. W. J. R. Crosby, D. A. S. Fraser, D. K. Sen, W. J. Webber, R. Wormleighton, D. W. H. Shale, I. R. Pounder.

Course 5, II Year; 3 hrs. problems per week, both terms.

The weekly sheet of prepared problems will be based on the content of courses 501, 504, 505, and will provide training in

operating the routine processes of the Calculus and will illustrate these by applications in Numerical Methods, Mechanics and Geometry. Students will be given an opportunity to have their difficulties in these courses cleared up.

501. Probability and Numerical Methods. D. A. S. Fraser, R. Wormleighton.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Definition of probability; binomial, Poisson, and normal distributions; frequency; sampling distributions. Examples of estimation, hypothesis testing, control charts, regression, and analysis of variance. Finite differences; operators; interpolation; numerical integration and solution of equations; inversion of matrices.

502. Algebra and Geometry. I. R. Pounder, D. W. H. Shale.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Complex numbers, elementary theory of equations, rational functions, vectors and matrices, coordinate systems, planes, lines, standard surfaces of the second degree, principal axes.

503. Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Introduction of differential and integral calculus with applications; limits, power series, the exponential and logarithmic functions; trigonometric and hyperbolic functions and their inverses.

Text books: Calculus—Sherwood and Taylor. Introduction to the Calculus—Beatty and Jenkins.

504. Differential Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Ordinary and partial differentiation, differentials, Taylor's theorem for functions of one or more variables, maxima and minima, transformations, convergence and uniform convergence, differential equations of the first order, linear differential equations with constant coefficients.

Text book: Advanced Calculus—Sokolnikoff.

505. Integral Calculus. W. J. Webber, D. W. H. Shale.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Methods of indefinite integration, definite integrals, multiple integrals, line and surface integrals, orthogonal functions.

Text book: Advanced Calculus—Sokolnikoff.

507. Differential Equations. N. Johnson, Mrs. C. C. Krieger-Dunaj, Mrs. L. H. Seshu.

Courses 1, 4, 6 and 8, III Year; 1 hr. lecture per week, both terms.

First order equations solvable by quadratures, linear equations of first and second orders, linear equations with constant coefficients of higher order.

Text books: Elementary Differential Equations—Kells. Differential Equations—Reddick.

508. Theory of Functions. Mrs. C. C. Krieger-Dunaj.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

Complex numbers, limits and series, analytic functions, Cauchy's theorem, Taylor and Laurent series, singularities and their significance, analytic continuation, contour integration, conformal mapping of one plane region on another.

Text books: Functions of a Complex Variable—Phillips. Theory of Functions—Copson. Theory of Functions as applied to Engineering Problems—Rothe, Ollendorf, and Pohlhausen. Introduction to Complex Variables and Applications—Churchill.

509. Differential Equations. Mrs. C. C. Krieger-Dunaj.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation with constant coefficients, operator methods, the linear partial differential equation, particular equations of the second order.

Text books: Differential Equations—Piaggio. Intermediate Differential Equations—Rainville. Fourier Series and Boundary Value Problems—Churchill.

510. Statistics. D. B. DeLury.

Course 8, IV Year; 2 hrs. lectures per week, first term. 1½ hrs. problems per week, first term; 3 hrs. problems per week, second term.

An introduction to the statistical methods used in the analysis and control of production processes.

511. Differential Equations. J. A. Steketee.

Courses 3 and 4, III Year; 2 hrs. lectures per week, both terms.

Course 3, III Year; 1½ hrs. problems per week, first term; 3 hrs. problems per week, second term.

First and second order ordinary differential equations, operational methods, variation of parameters, solution in series, Fourier series, Bessel and Legendre functions, the Laplace transform, applications to first and second order partial differential equations, applications to problems in fluid flow systems, heat conduction, vibrating systems and stress analysis.

512. Probability and Statistics. D. B. DeLury.

Course 4, II Year; 2 hrs. lectures per week, both terms.

Frequency distributions and probability laws; binomial, Poisson,

and normal distributions and the treatment of samples drawn from them; tests of significance and confidence limits; control charts; introduction to the analysis of variance.

513. Probability and Statistics Laboratory. D. B. DeLury, D. J. Clough, J. F. Keffer.

Course 4, II Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises associated with the material of the companion lecture subjects.

514. Numerical Analysis. Department of Mathematics.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Course 4, IV Year; 2 hrs. lectures per week, both terms (1960–61 only).

Vectors, matrices, inversion of matrices and eigenvalues, regression theory and calculations, elements of the design of experiments, theory of sampling.

515. Numerical Analysis Laboratory. Department of Mathematics.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Course 4, IV Year; 3 hrs. laboratory per week, both terms (1960–61 only).

Practice in the numerical analysis methods and techniques dealt with in the lecture subject. Practical problems, as well as problems of a fundamental mathematical nature, will be covered.

516. Differential Equations. Problems. A. W. Walker.

Course 1, III Year; 1½ hrs. laboratory per week, both terms.

Problems based on the content of Lecture Course 507.

Problems must be done during the laboratory period.

MATHEMATICS, APPLIED

520. Applied Mathematics in Engineering. Staff in Mechanical Engineering.

Course 3, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term; 3 hrs. problems per week, both terms.

Dimensional analysis and similarity, numerical methods, relaxation techniques, approximate solutions, digital and analogue computation, introduction to statistics.

521. Differential Equations of Mathematical Physics. D. Naylor.

Course 5, IV Year; 2 hrs. lectures per week, both terms.

The underlying theory and important particular equations, including eigenvalues and eigenfunctions, Fourier series, spherical and cylindrical harmonics, vibration of strings, membranes, and rods, sound waves, water waves, equation of heat conduction.

Text books: Fourier series and Boundary Value Problems—Churchill. Modern Operational Mathematics in Engineering—Churchill. Partial Differential Equations of Mathematical Physics—Webster.

523. Adjustment of Observations. H. L. Macklin.

Courses 1_b, IV Year; 3 hrs. per week, second term.

Problems illustrating the application of Least Squares to the adjustment of observed data, with particular reference to surveying measurements.

No laboratory reports shall be written outside the assigned teaching hours.

524. Operations Research I.

Course 4, IV Year; 2 hrs. lectures per week, both terms (commencing 1961–62).

Methods for establishing economic optima in industrial operations; mathematical models for allocation of resources, inventory and production; applied probability in machine interference, maintenance and replacement, competition and bidding. Measures of effectiveness, evaluation of objectives, tests of validity.

525. Operations Research I Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, both terms (commencing 1961–62).

Practical work to accompany subject 524.

526. Operations Research II.

Course 4, IV Year; 2 hrs. lectures per week, second term (commencing 1961–62).

Techniques of analytical, iterative and statistical procedures used in Operational Research.

527. Operations Research II Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, second term (commencing 1961–62).

Practical work to accompany subject 526.

METALLURGICAL ENGINEERING

530. Metallurgy. The Staff in Metallurgy.

Course 8, II Year; 2 hrs. lectures per week, both terms.

An introductory course describing the theory and practice of metallurgical processes and operations.

531. Principles of Extractive Metallurgy. L. M. Pidgeon.

Course 8, III Year; 2 hrs. lectures per week, both terms.

A general discussion of the fundamental principles of extractive metallurgy with reference to the production of the more important metals.

532. Principles of Extractive Metallurgy Laboratory. H. U. Ross, A. W. Lund.

Course 8, III Year; 3 hrs. laboratory per week, first term; 6 hrs. continuous laboratory per week, second term.

Experiments in pyrometry, furnaces, roasting, smelting, leaching, retorting, refining, electrolysis designed to illustrate the principles underlying these operations.

One laboratory report per week.

533. Principles of Physical Metallurgy. G. B. Craig.

Courses 5m and 8, III Year; 2 hrs. lectures per week, both terms.

A discussion of the structure of solids with particular reference to x-ray methods of investigation; the solidification of metals, and the plastic deformation of metals with reference to the dislocation theory.

534. Principles of Physical Metallurgy Laboratory. G. B. Craig.

Courses 5m, 5n and 8, III Year; 3 hrs. laboratory per week, both terms.

Practical work relating to subject 533.

535. Metallurgical Thermodynamics. I. G. B. Craig.

Course 8, III Year; 2 hrs. lecture per week, both terms.

The physico-chemical principles of metallurgy.

536. Metallurgical Problems Laboratory. A. W. Lund, H. U. Ross.

Course 8, III Year; 4 hrs. laboratory per week, both terms.

Problems in chemistry, physical chemistry and thermodynamics as applied to metallurgical processes and operations relating to subjects 531 and 535.

538. Physical Metallurgy. H. U. Ross.

Course 1, II Year; Course 2, IV Year; 2 hrs. lectures per week, second term.

A short course on the structure and mechanical properties of metals and alloys and on the influence of heat and mechanical treatment upon these properties. Reference is made particularly to steels and the more-important non-ferrous alloys. Welding and corrosion of metals is also included.

539. Metallurgy. H. U. Ross.

Courses 2 and 9, III Year; 1 hr. lecture per week, second term.

An introductory course describing the theory and practice of metallurgical processes and operations.

540. Metallurgical Problems Laboratory. H. U. Ross.

Course 8, II Year; 2 hrs. laboratory per week, second term.

Problems in chemistry and physical chemistry as applied to metallurgical processes relating to subject 530.

550. Non-Ferrous Extractive Metallurgy. L. M. Pidgeon.

Course 8, IV Year; 1 hr. lecture per week, both terms.

Extractive metallurgy of the non-ferrous metals, including electrometallurgy.

551. Ferrous Extractive Metallurgy. H. U. Ross.
Course 8, IV Year; 1 hr. lecture per week, both terms.
Extractive metallurgy of iron and steel.

552. Extractive Metallurgy Laboratory. H. U. Ross, A. W. Lund.
Course 8, IV Year; 6 hrs. continuous laboratory per week, first term.
A continuation of subject 532.
Four laboratory reports per term.

553. Metallurgical Thermodynamics II. G. B. Craig.
Course 8, IV Year; 2 hrs. lectures per week, both terms.
A study of chemical equilibria at high temperatures in extractive metallurgy.

554. Metallurgical Problems Laboratory. G. B. Craig, A. W. Lund.
Course 8, IV Year; 2 hrs. laboratory per week, both terms.
Problems relating to subjects 550, 551 and 553.

555. Metallurgy. L. M. Pidgeon.
Courses 2 and 9, IV Year; 1 hr. lecture per week, both terms.
The extractive metallurgy of the common metals, together with the calculations necessary to understand metallurgical processes.

556. Metallurgy Laboratory. A. W. Lund, H. U. Ross.
Course 2, IV Year; 6 hrs. continuous laboratory per week for one half of second term.
Similar to subject 532.
One laboratory report per week.

557. Physical Metallurgy. W. C. Winegard, G. B. Craig.
Courses 5m and 8, IV Year; 2 hrs. lectures per week, both terms.
A continuation of subject 533 in which the heat treatment of ferrous and non-ferrous alloys is discussed.

558. Physical Metallurgy Laboratory. W. C. Winegard.
Course 8, IV Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.
Practical work relating to subject 557.

561. Physical Metallurgy. P. D. Hedgecock.
Courses 5a, 5c, 5e, 5g, 5n, 5s, 5t, III Year; 1 hr. lecture per week, both terms.
A short course in Physical Metallurgy; structure of metals and alloys; effects of mechanical distortion and heat treatment on structure; relation between structure and mechanical properties; and properties of some steels and non-ferrous alloys.

562. Physical Metallurgy Laboratory. W. C. Winegard.
Course 5m, IV Year; 3 hrs. laboratory per week, second term.
Practical work relating to subject 557.

563. Physics of Metals Seminar. G. B. Craig, W. C. Winegard.

Course 5m, IV Year; 3 hrs. per week, both terms.

Each student prepares and presents seminars on topics concerning metal physics. The topics may include nucleation theory, dislocations, imperfections, electron theory, ferromagnetism, phase transformations, electrical properties, grain boundaries, metal surfaces, thermal properties, diffusion or any topic satisfactory to both staff and student.

564. Physical Metallurgy. P. D. Hedgecock.

Courses 3 and 4, II and IV Years; 2 hrs. lectures per week, both terms.

A general course in Physical Metallurgy, dealing with the structure of metals and alloys, with special reference to the ferrous alloys of practical importance. The influence of mechanical deformation, heat treatment, and composition on the structure is considered, and the relation between the structure and mechanical properties is examined.

565. Physical Metallurgy Laboratory. P. D. Hedgecock.

Courses 3 and 4, II and IV Years; 3 hrs. laboratory per week for six weeks, second term.

A practical course illustrating the principles dealt with in subject 564. Experiments are conducted on the heat-treatment of ferrous and non-ferrous alloys.

566. Physical Metallurgy. P. D. Hedgecock.

Course 7, III Year; 2 hrs. lectures per week, first term.

A short course on the structure and properties of metals and alloys, and the effect of stress and temperature on these properties. Particular emphasis is placed on the relationship between structure and the electrical properties of metals.

MODERN LANGUAGES

610. English.

All Courses, I Year; 1 hr. lecture per week, both terms.

A course in essay writing, based on the study of examples of expository prose. Texts will be announced at the opening of the session.

611. English Literature.

All Courses, IV Year; 1 hr. lecture per week, both terms.

A course in the drama, the novel and poetry based on the study of the following texts: Shakespeare, *King Lear*; Synge, *The Playboy of the Western World* and *Riders to the Sea*; Miller, *Death of a Salesman*; Wilder, *The Skin of our Teeth*; Emily Bronte, *Wuthering Heights*; Hemingway, *The Sun Also Rises*; Golding, *The Land of the Flies*; Selections from the Major Poets, English and American (Charles M. Coffin, editor).

Students are expected to read the plays and novels during the

summer preceding their entry into the Fourth Year. Term work will include assignments based on texts read during the summer, one substantial essay, and two class tests. Students who obtain a satisfactory term mark will not be required to write a final examination.

PHYSICAL EDUCATION

640. Physical Education.

All courses, I Year.

By order of the Board of Governors each first year student must register for, and satisfactorily complete, the University requirement in Physical Education. This requirement includes a medical examination by the University Health Service. Each year of failure to fulfil the regulations renders the student liable to a special fee of $50.00.

Physical Education credits may be earned by participation in intercollegiate and intramural sports, swimming, water safety, and instructional classes.

Exemptions: (1) one year's satisfactory standing in physical education at this or any other University (2) if age is 30 years or more (3) ex-military service (4) completion of one year's course in the U.N.T.D., C.O.T.C. or U.R.T.P. (5) exemption by the University Health Service (6) special consideration.

PHYSICS

650. Properties of Matter; Mechanics and Heat. D. G. Ivey.

Course 5, I Year; 3 hrs. lectures per week, both terms.

Text book: Mechanics, Heat and Sound—Sears.

651. Properties of Matter; Mechanics and Heat Laboratory. D. G. Ivey, Miss K. M. Crossley and the staff in Physics.

Course 5, I Year; 3 hrs. laboratory per week, both terms; 1 hr. tutorial per week, both terms.

To accompany subject 650.

Twelve laboratory reports.

652. Physics. R. W. McKay.

Course 5, II Year; 3 hrs. lectures per week, both terms.

Fundamental theory of electricity and magnetism. Acoustic and electromagnetic waves. Interference, diffraction and polarization of light waves. Elementary atomic physics.

Text book: Currents, Fields and Particles—F. Bitter.

655. Physics Laboratory. R. W. McKay.

Course 5, II Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.

To accompany subject 652.

656. Physics of Solids and Fluids. C. Barnes.

Courses 5e, 5g, 5m, 5s, III Year; 1 hr. lecture per week, both terms.

Elasticity, viscosity, equations of fluid motion, wave propagation, heat conduction, potential theory.

657. Thermodynamics and Kinetic Theory. J. C. Stryland.

Course 5, III Year; 2 hrs. lectures per week, both terms.

The fundamental principles of thermodynamics, kinetic theory, and statistical mechanics.

659. Physical Laboratory. J. C. Stryland.

Course 5, III Year; 3 hrs. laboratory per week, both terms.

To accompany subjects 656 and 657.

Twelve laboratory reports.

660. Optics.

Course 5s, III Year; 1 hr. lecture per week, both terms.

The theory and techniques of experimental spectroscopy: dispersion, resolving power, light power; frequency measurements, intensity measurements in emission and absorption; the effects of source conditions on line widths.

Reference books: Experimental Spectroscopy—Sawyer. Practical Spectroscopy—Harrison, Lord and Loofbourow. Measurement of Radiant Energy—Forsythe. The Principles of Optics—Hardy and Perrin.

661. Optics.

Course 5s, III Year; 3 hrs. laboratory per week, first term.

Supplementary to subject 660.

663. Atomic Physics. Miss E. J. Allin, K. G. McNeill, H. L. Welsh.

Courses 5e, 5c, 5g, 5m, 5n, 5s and 5t, IV Year; 3 hrs. lectures per week, both terms.

Introduction to quantum theory, atomic, molecular and nuclear physics.

664. Nuclear Reactor Theory. B. Davison.

Course 5n, IV Year; 2 hrs. lectures per week, both terms.

The neutron cycle, multiplication constant, critical size in a thermal reactor. Elementary treatment of kinetics including transients and poisoning.

665. Physical Laboratory. The staff in Physics.

Course 5s, IV Year; 9 hrs. laboratory per week, both terms.

Courses 5c, 5m and 5n, IV Year; 6 hrs. laboratory per week, both terms.

Accompanying the lecture subjects 663, 664, 666, and 669.

666. Advanced Optics.

Course 5s, IV Year; 2 hrs. lectures per week, both terms.

Diffraction, interference, and polarisation.

Text books: Diffraction of Light, X-Rays, etc.—Meyer. Applications of Interferometry—Williams. Cours d'Optique—Bruhat. Theory of Optics—Drude.

669. Introductory Quantum Mechanics. J. Van Kranendonk.

Course 5s, IV Year; 1 hr. lecture per week, both terms.

Text books: Elementary Wave Mechanics—W. Heitler. Introduction to Quantum Mechanics—L. Pauling and E. B. Wilson.

670. Theory and Application of Geophysical Methods. F. Grant.

Course 5g, IV Year; 2 hrs. lectures per week, both terms.

A course on the mathematical theory of magnetic, electrical, seismic and gravitational methods in applied geophysics.

671. Exploration Geophysics. G. F. West.

Course 9, IV Year; 1 hr. lecture per week, both terms.

An introduction the physical principles underlying the important methods of geophysical prospecting. Particular attention is given to seismic, gravitational, magnetic and electromagnetic methods.

Text book: Introduction to Geophysical Prospecting—Dobrin.

672. Geophysics. F. Grant.

Course 5g, IV Year; 6 hrs. laboratory per week, both terms.

To accompany subject 670.

673. Geophysics. G. F. West.

Course 9, IV Year; 3 hrs. laboratory per week, both terms.

To accompany subject 671.

674. Physics of the Earth. J. T. Wilson, M. G. Rochester.

Course 5g, III Year; 1 hr. lecture per week, both terms.

Basic considerations of gravitation; the figure of the earth and isostacy; terrestrial magnetism and atmospheric electricity; seismology; internal structure and constitution of the earth; radioactivity, geothermal heat and the age of the earth.

Text books: Physics and Geology—Jacobs, Russell and Wilson. Introduction to Geophysics—Howell.

675. Physics of the Earth. J. T. Wilson, M. G. Rochester.

Course 5g, IV Year; 1 hr. lecture per week, both terms.

Basic considerations of gravitation; the figure of the earth and isostasy; terrestrial magnetism and atmospheric electricity; seismology; internal structure and constitution of the earth; radioactivity, geothermal heat and the age of the earth.

Text books: Physics and Geology—Jacobs, Russell and Wilson. Introduction to Geophysics—Howell.

676. The Structure and Properties of Matter. J. N. P. Hume, J. D. Prentice, M. G. Rochester, N. R. Steenberg.
Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.
An introduction to the mechanical, electrical, magnetic, thermal and optical properties of matter in terms of atoms.

677. Physics Laboratory. The Staff in Physics.
Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; twelve 3 hr. periods.
To accompany subject 676.

678. Engineering Data Processing. The Staff in Physics.
Course 4, IV Year; 2 hrs. lectures per week, first term (commencing 1961–62).
A course in programming and coding for the digital computer.

679. Engineering Data Processing Laboratory. The Staff in Physics.
Course 4, IV Year; 3 hrs. laboratory per week, first term (commencing 1961–62).
Practical work to accompany subject 678.

PRACTICAL EXPERIENCE

690. Practical Experience.
Students in the courses listed below are required to have, before graduation, practical work of a nature acceptable to the department concerned. This may be obtained during the summer vacations but work done before entering the Faculty may also meet the requirements. Instructions will be issued by the departments concerning the type of work which is acceptable. Practical experience certificate forms may be obtained from the departments and should be returned there when completed.

Course 1	600 hours
Course 2	6 months
Course 3	1200 hours
Course 4	1200 hours
Course 6	800 hours
Course 7	1200 hours
Course 8	800 hours
Course 9	6 months

SURVEYING

All students taking Field Work in subjects 710 to 720, inclusive, will be required to use Departmental Field Books.
No laboratory reports shall be written outside the assigned teaching hours.

710. Surveying. O. J. Marshall, H. L. Macklin, B. J. Haynes.
Courses 1, 2 and 9, I Year; 1 hr. lecture per week, first term.
General principles and practice of surveying with the tape, the transit, and the level, and computation of corrections, azimuths, bearings, latitudes and departures, co-ordinates and areas.

Text book: Surveying—Philip Kissam.

Reference books: Plane Surveying—Tracy. Elementary Surveying—Breed and Hosmer. Surveying—Breed.

712. Field Work. O. J. Marshall, H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Courses 1, 2 and 9, I Year; 3 hrs. per week, first term.

Practice in chaining; keeping of field notes; the use of the transit in surveying closed figures and traverse lines; plotting by co-ordinates; computing of areas; instrumental work with the level and calculating the volume of excavations.

714. Surveying. O. J. Marshall, B. J. Haynes.

Course 1, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Simple, reverse, compound and spiral curves as applied to Highway and Railroad surveying. Main features of mine and hydrographic surveying. Construction surveying dealing with cross sectioning, earthwork, quantities, mass or haul diagram, super elevation, vertical curves, and layout of roads and sewers.

Text book: Route Surveys—Skelton.

715. Surveying. H. L. Macklin.

Courses 2 and 9, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Mine surveying, with problems related thereto. Simple curves, stadia and plane table topographical surveying. Practical determination of time, latitude and azimuth by methods adapted to the surveyor's transit.

Text book: Surveying for Civil Engineers—Kissam.

716. Surveying Laboratory. O. J. Marshall, H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Course 1, II Year; 3 hrs. per week, both terms.

First term: Field problems, in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy, and earth work quantities.

717. Surveying Laboratory. H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Courses 2 and 9, II Year; 3 hrs. per week, first term; 2 hrs. per week, second term.

First term: Field problems in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy and mine problems.

718. Construction Surveying. B. J. Haynes.

Course 1, III Year; 2 hrs. lectures per week, second term (1960–61 only).

Construction surveys are taken up under the following headings, and the work is treated as applying equally to railroads, highways, canals, transmission lines, etc.

Earthwork:

(*a*) Cross sectioning.
(*b*) Computation of volume.
(*c*) Mass or haul diagram.

Transition and Vertical curves (including super-elevation).
Layout of roads and sewers.

720. Survey Camp. O. J. Marshall, H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Course 1, III Year; Aug. 15 to Sept. 17; Courses 2 and 9, III Year; Aug. 22 to Sept. 17—Gull Lake or Dorset.

Course 1:

(*a*) Secondary Triangulation and Base Line Measurements.
(*b*) Highway and Railway Location.
(*c*) Cross Sectioning and Computation of Earthwork.
(*d*) Stadia and Plane Table Topography.
(*e*) Observations for Time, Azimuth, and Latitude.

Courses 2 and 9:

(*a*) Stadia and Plane Table Topography.
(*b*) Mine Surveying, using overhead stations.
(*c*) Shaft plumbing and use of Auxiliary Telescope.

Students in Courses 1, 2 and 9 will be required to take the Survey Camp between the Second and Third Years; on failure to do so, this subject will be carried as a supplemental in the Third Year.

Application to defer attendance at the Camp must be made to the Secretary of the Faculty before July 15th.

721. Survey Camp. O. J. Marshall, B. J. Haynes.

Course 1b, IV Year; Sept. 6 to Sept. 17 (2 weeks) Dorset.

Triangulation, traverses, levelling and astronomical observations by precise methods.

THESIS

730. Thesis.

All courses, IV Year.

Every student in the Fourth Year is required to prepare a thesis on an approved subject. Instructions will be issued by the departments concerned.

In some cases written presentation is required, in others oral and written, or it may consist of a research problem followed by a written thesis or report.

SECTION IX. EXAMINATIONS

ANNUAL EXAMINATIONS

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in some subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations and laboratory work in each subject is 50% and a student must obtain a weighted average of 60% in order to pass in the work of the year. He shall be required to pass a supplemental examination in each subject in which he obtains less than 50%. Subjects will be weighted according to the number of hours devoted to them, the hours assigned to laboratory subjects being given one half the weight of those in lecture subjects.

5. Honours and scholarships will be awarded upon the basis of the weighted average.

6. Honours will be awarded to a student, who at the Annual Examinations passes in all written and laboratory subjects and who also obtains a weighted average of 75% on the work of the year.

7. Honour graduate standing will be granted to those who obtain honours in the final year and in one previous year.

8. A student who fails in the work of any year will be permitted, unless otherwise ineligible, to register in a subsequent session for the purpose of repeating the year, subject to the following conditions:

(a) Only one such repetition will be allowed in the student's entire undergraduate course. A failure in an engineering course at any other institution will be counted in the same way as a failure at this university.

(b) During any such repetition, the full programme of prescribed instruction must be taken.

(c) Second, Third, or Fourth Year work may be repeated in the session immediately following that in which the failure occurs.

(d) First Year work may be repeated only after the lapse of one full session, but this lapse requirement will be waived in the event of a withdrawal on or before February 15th.

Any student wishing to re-register in First Year is not automatically granted re-admission to this Faculty but must file a new application (as outlined in Paragraph 7, Section V) which will be subject to current regulations concerning restriction of registration.

9. A student who has twice failed the work of his first year at this or another university shall not be granted admission to any course.

10. A student whose attendance at lectures or laboratories, or whose work, is deemed by the Council of the Faculty in which he is registered, to be unsatisfactory, may have his registration cancelled at any time by the Council of the Faculty.

11. A student should submit to Council immediately after its occurrence, evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

12. A student will not be allowed to write any examinations if he has not paid all fees and dues for which he is liable at that time.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on the 8th day of August, 1960. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 15th, and the fee named in Sec. VI, para. 11, received by the Chief Accountant not later than August 5th. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Chief Accountant, for the January examinations not later than December 1st and for the April examinations not later than March 1st.

3. Except under very exceptional circumstances, pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by the order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

EXTRA-CURRICULAR ACTIVITIES AND ACADEMIC CREDIT

It is in general desirable for students to engage to a reasonable extent in extra-curricular activities in order that they may not become too narrowly professional in interests and outlook, but it will be obvious that no academic credit or consideration can be given for such activities. Some offices in student organizations require quite large amounts of time for the proper performance of the duties connected with them, and it is therefore strongly recommended that students, particularly those whose academic records are not high, consult a senior member of Staff before allowing themselves to be nominated for such offices.

SECTION X. MEDALS, PRIZES, SCHOLARSHIPS, BURSARIES AND FELLOWSHIPS

Through the generosity of friends of the University, governments and commercial organizations, encouragement has been given to both undergraduate and graduate work in the various branches of engineering studies by establishing the following scholarships, prizes, bursaries, and medals.

Matriculation students are advised to consult the University of Toronto Calendar on Admission Requirements and Scholarships for complete details of awards available to students entering this Faculty.

Where it is necessary to make application for an award it is so stated in the description and particulars are given as to how the application should be made. In all other cases the award is made on the recommendation of the Faculty Council and no application is necessary.

In order to be eligible for a medal, prize, scholarship, bursary, fellowship or other awards granted solely upon standing obtained at an annual or special examination or upon an essay, or term work, or other academic rating, a candidate must obtain honours at such annual or special examination or upon such essay, term work, or other academic rating unless the statute respecting the award or medal specifies that standing lower than honours may be accepted.

When an award or medal is granted upon standing obtained on part of the work of any academic year the candidate must obtain standing but need not obtain honours in the work of the academic year as a whole, provided he obtains honours in the part concerned, unless the statute respecting the award or medal specifies otherwise.

No medal, prize, scholarship, bursary, fellowship or other award will be granted to a candidate who is conditioned in any subject at an annual examination or in Physical Education unless the statute respecting the award or medal specifies otherwise.

A candidate will not be permitted to receive more than one award in a session unless the statute establishing each of the awards concerned or the Calendar specifies otherwise. Only one of those marked by an asterisk may be held in any one year. A candidate who would, but for this provision, have received more than one award may have his name so published in the class lists.

A candidate who has spent two sessions in any year of an undergraduate course is not eligible to compete for any award at the annual examinations of that year.

Medals, after they have been suitably engraved, will be given without delay to the winners or forwarded to them by registered mail.

Awards granted to members of graduating classes other than awards for graduate study and research, will be paid in one instalment as soon as possible after the granting of the awards.

All other awards will be paid (i) if of the value of $100 or less, in one instalment on November 20 and (ii) if of the value of more than $100 in two equal instalments, the first on November 20 and the second on January 20, in the session following the granting of the awards provided that no payment is made to a candidate (*a*) who is not in regular attendance upon lectures and laboratory classes in the Faculty, or if the Calendar so specifies, in the course in which the award is established or granted (*b*) who does not present at the Chief Accountant's Office before each payment a certificate of attendance upon lecture and laboratory classes signed by two senior members of the staff.

The Senate may, on the recommendation of the Faculty, permit a candidate to whom an award has been granted to postpone attendance upon lectures and laboratory classes for one year. Further postponement may be permitted on application.

Name	Amount	Application required	Available only to a limited group or single course	See page
AVAILABLE TO STUDENTS ENTERING THE FIRST YEAR				
J. P. Bickell Foundation Scholarships	$16,800	Yes	Yes	134
Class of 1937 Engineering Bursary	$100	Yes	No	136
Dominion Magnesium Limited Bursary	$400	Yes	Yes	136
Dominion-Provincial Student Aid Bursaries, Type A	—	Yes	No	137
Engineering Alumni Admission Bursaries	$500	Yes	No	138
Engineering Alumni Admission Scholarship	$500	Yes	No	138
Hagarty Memorial Scholarship	$60	Yes	Yes	140
Inco Scholarship	$300	Yes	No.	141
The Leonard Foundation Scholarships	—	Yes	Yes	142
O.H.A. War Memorial Scholarship	$200	Yes	Yes	147
Ontario Chapter American Society for Metals Bursary	$400	Yes	Yes	133
A.P.E.O. Admission Scholarship	$500	Yes	No	149
Simpson-Sears Limited (Northern Ontario) Scholarship	$100	Yes	Yes	152

Name	Amount	Application required	Available only to a limited group or single course	See page
Smith and Stone Limited Bursaries	$150	Yes	Yes	152
Students' Administrative Council Admission Scholarship	$300	Yes	Yes	153
U.T.S. Engineering Scholarship	$250	Yes	Yes	156
Wallberg Admission Scholarships (2)	$1000	Yes	No	156
AVAILABLE TO STUDENTS COMPLETING THE FIRST YEAR				
American Society for Metals Foundation for Education and Research Scholarship	$500	No	Yes	133
Atkinson Incourse Bursaries	—	Yes	No.	133
Babb Bursary Fund	—	Yes	Yes	133
Baptie Scholarship	—	No	Yes	134
Canadian Bechtel Limited Bursaries	$1200	Yes	No	134
J. P. Bickell Foundation Scholarships	—	No	No	134
T. H. Bickle Prize	$30	No	Yes	135
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	137
*John M. Empey Scholarship	$100	No	No	137
*Hydro-Electric Power Commission Scholarship	$300	No	No	141
Inco Scholarship	—	Yes	Yes	141
Johnson's Wax Scholarship	$600	No	Yes	141
Kimberly-Clark Scholarship	$500	No	No	142
John Wolfe McColl Awards	—	Yes	No.	143
Garnet W. McKee-Lachlan Gilchrist Scholarship in Engineering Physics	$60	No	Yes	143
MacLennan-LacLeod Memorial Prize	$25	No	No	145
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	145
Orenda Engines Scholarship	$500	No	Yes	148
*Paulin Memorial Scholarship	$425	No	Yes	148
Procter and Gamble Bursary	—	Yes	No	149
*Professional Engineers Scholarship	$250	No	Yes	149
*Ransom Scholarship in Chemical Engineering	$150	No	Yes	150
Frederick W. Schumacher Scholarship	—	Yes	Yes	151

Name	Amount	Application required	Available only to a limited group or single course	See page
S. Ubukata Fund	—	Yes	Yes	154
University Alumni Association War Memorial Scholarships	—	Yes	No	155
University Naval Training Division Bursaries	$100	Yes	Yes	155
University of Toronto General Bursaries	—	Yes	No	155
University of Toronto Alumni Association—Montreal Branch Bursaries	—	Yes	No	155
*Wallberg Undergraduate Scholarships (2)	$1000	No	No	155
AVAILABLE TO STUDENTS COMPLETING THE SECOND YEAR				
*Harvey Aggett Memorial Scholarship	$75	No	No	132
Ardagh Scholarship	$150	No	Yes	133
Automotive Transport Association Bursary	—	Yes	No	133
Babb Bursary Fund	—	Yes	Yes	133
Canadian Bechtel Limited Bursaries	$1200	Yes	No	134
J. P. Bickell Foundation Bursaries	—	Yes	Yes	135
J. P. Bickell Foundation Scholarships	—	No	Yes	134
T. H. Bickle Prize	$30	No	Yes	135
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	137
*John M. Empey Scholarship	$100	No	No	137
J. A. Findlay Scholarship	—	No	Yes	139
Hugh Gall Award	$140	Yes	No	139
*Hydro-Electric Power Commission Scholarship	$300	No	No	141
Johnson's Wax Scholarship	$600	No	Yes	141
Kimberly-Clark Scholarship	$500	No	No	142
The Lever Brothers Scholarships	$300	No	Yes	142
*Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarships	—	No	Yes	144
Charles Gordon Manning Prize	—	No	No	145

Name	Amount	Application required	Available only to a limited group or single course	See page
*Marsland Engineering Ltd. Scholarship................	$250	No	Yes	145
*William R. Worthington Memorial Scholarship	$400	No	Yes	156
W. G. Millar Memorial Scholarship.........	$250	Yes	Yes	146
James L. Morris Memorial Prize	$125	No	Yes	146
Northern Electric Undergraduate Scholarship.......	$500	No	Yes	147
Orenda Engines Scholarship ...	$500	No	Yes	148
*Spruce Falls Power and Paper Company Scholarships.......	$800	No	No	147
William Storrie Memorial Scholarship	$100	No	Yes	153
*Professional Engineers Scholarship..	$250	No	Yes	149
*Rhodes Scholarship...........	£400	Yes	No	150
Scottish Rite Masons Bursary .	$200	Yes	Yes	151
Frederick W. Schumacher Scholarship...............	—	Yes	Yes	151
Edith Tyrrell Memorial Bursary...................	$500	Yes	Yes	154
University Alumni Association War Memorial Scholarships .	—	Yes	No	155
University of Toronto General Bursaries.................	—	Yes	No	155
*Wallberg Undergraduate Scholarships...............	$500	No	No	155
AVAILABLE TO STUDENTS COMPLETING THE THIRD YEAR				
Allied Chemical Canada Limited Scholarship........	$850	No	Yes	132
Babb Bursary Fund..........	—	Yes	Yes	133
F. W. Baldwin Prize..........	$75	No	Yes	134
Canadian Bechtel Limited Bursaries.................	$1200	Yes	No	134
J. P. Bickell Foundation Bursaries..................	—	Yes	Yes	135
T. H. Bickle Prize............	$30	No	Yes	135
*Boiler Inspection and Insurance Company Scholarship.......	$150	No	Yes	135
*California Standard Company Scholarship	$400	No	Yes	136

Name	Amount	Application required	Available only to a limited group or single course	See page
Chemical Institute of Canada Prize	$25	No	Yes	136
Archie B. Crealock Memorial Prize	$50	No	Yes	136
Dow Chemical of Canada Limited Award	$500	No	Yes	137
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	137
*John M. Empey Scholarship	$100	No	No	137
E.I.C. Prize	$50	No	Yes	138
Engineering Society Semi-Centennial Award	$75	No	No	139
J. A. Findlay Scholarship	—	No	Yes	139
Chester B. Hamilton Scholarship	$500	No	Yes	140
Heating and Air Conditioning Engineers Prize	$75	No	No	140
Hudson Bay Mining and Smelting Company Limited Scholarships	$800	Yes	Yes	141
*Hydro-Electric Power Commission Scholarship	$300	No	No	141
*Jenkins Scholarship in Engineering	$200	No	No	141
Johnson's Wax Scholarship	$600	No	Yes	141
The Lever Brothers Scholarship	$300	No	Yes	142
Loan Funds	—	Yes	No	164
J. A. D. McCurdy Prize	$75	No	Yes	143
Alexander MacLean Scholarship	$250	No	Yes	144
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	145
Mobil Oil of Canada Limited Scholarship	$400	No	Yes	146
Northern Electric Undergraduate Scholarship	$500	No	Yes	147
Orenda Engines Scholarship	$500	No	Yes	148
*Professional Engineers Scholarship	$250	No	Yes	149
Rhodes Scholarship	£400	Yes	No	150
RCE Memorial Scholarship	$125	Yes	Yes	151
Frederick W. Schumacher Scholarship	—	Yes	Yes	151

Name	Amount	Application required	Available only to a limited group or single course	See page
William Storrie Memorial Scholarship................	$100	No	Yes	153
*Spruce Falls Power and Paper Company Scholarships......	$800	No	No	147
Edith Tyrrell Memorial Bursary	$500	Yes	Yes	154
University Alumni Association War Memorial Scholarships .	—	Yes	No	155
University of Toronto General Bursaries..................	—	Yes	No	155
*Wallberg Undergraduate Scholarships..............	$500	No	No	155
Available to Students Completing the Fourth Year				
Henry G. Acres Medal........	—	No	Yes	132
J. P. Bickell Foundation Bursaries..................	—	Yes	Yes	135
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	137
Electrical Manufacturing Co. Limited Prize..............	$25	No	Yes	137
Heating and Air Conditioning Engineers Prize............	$75	No	No	140
Johnson Foundation Scholarship Award.........	—	Yes	Yes	160
Loan Funds..................	—	Yes	No	164
Massey-Ferguson Ltd. Scholarships (2)............	$500	Yes	Yes	145
Ontario Municipal Electric Association Bursary	$300	Yes	Yes	148
Professional Engineers Gold Medal	—	No	No	149
William Storrie Memorial Scholarship................	$200	No	Yes	153
"Second Mile Engineer" Award	$100	No	Yes	152
Trane Company of Canada Limited Prize..............	$200	No	No	154
University of Toronto General Bursaries..................	—	Yes	No	155
Available to Graduates				
Athlone Fellowships..........	—	Yes	No	157
C.I.L. Fellowships in Chemistry	$4000	Yes	Yes	157

Name	Amount	Application required	Available only to a limited group or single course	See page
Canadian Lumbermen's Association Timber Research Fellowship	$1250	Yes	No	157
Commonwealth Scholarships	—	Yes	No	158
Consolidated Mining and Smelting Company Fellowship	$1000	Yes	No	157
1851 Exhibition Science Research Scholarships	£275	Yes	Yes	158
Imperial Oil Graduate Research Fellowships	$4000	Yes	Yes	159
International Nickel Graduate Research Fellowships	$2000	Yes	Yes	159
S. C. Johnson Foundation Scholarship Award	—	Yes	Yes	160
McCharles Prize	$1000	No	No	160
The University of Manchester Toronto Fund	£100	Yes	No	160
National Sewer Pipe Limited Scholarship	$500	Yes	Yes	161
Nipissing Mining Research Fellowships	$975	Yes	No	161
H. W. Price Research Fellowship in Electrical Engineering	—	Yes	Yes	161
Raymond Priestley Fellowship	£450	Yes	No	161
Rhodes Scholarship	£400	Yes	No	150
Royal Institution of Great Britain Science Research Scholarships	£350	Yes	No	162
Steel Company of Canada, Ltd., Fellowship	$1500	Yes	Yes	162
Spruce Falls Power and Paper Company Fellowships	$1200	Yes	No	162
1940 Toronto Fund	—	Yes	No	163
Wallberg Research Fellowships	$6000	Yes	No	163
Charles G. Williams Fellowship	$1500	Yes	Yes	163
Garnet W. McKee Loan and Scholarship Fund	$800	Yes	Yes	163

NOTE—As the value of an endowed scholarship or prize is dependent on the actual income of the fund, it is possible that the value of certain scholarships and prizes at the time of payment may be less than the amount stated in the calendar.

In those cases where the amount of the award is not payable from income earned on an endowed fund, payment will be dependent on the receipt of the amount of the annual award from the donor.

HENRY G. ACRES MEDAL

The Henry G. Acres Medal is the gift of Mrs. Henry G. Acres in memory of her late husband, Henry G. Acres, M.E., D.Sc., a graduate of the School of Practical Science in the class of 1903. Throughout his professional life Dr. Acres was associated with major power developments in Canada and abroad. As chief hydraulic engineer for the Hydro-Electric Power Commission of Ontario in the period 1911 to 1923, he was responsible for the design and construction of nearly twenty power plants, including the Queenston-Chippawa development. Entering private practice in 1924, and until his death in 1945, he continued to widen and extend his interests. He became chief engineer of the Grand River Conservation Commission and responsible for the design and construction of the Shand dam and related work. Later, he was consulting engineer for the extensive power developments at Shipshaw on the Saguenay River, which was vital to the production of aluminum for war purposes. Many of the provinces of Canada sought his services and he advised with respect to work in Newfoundland, South America and India.

This medal is awarded annually to the student in the Fourth Year who is registered in the course in Civil, Mechanical, or Electrical Engineering, and who obtains the highest aggregate percentage at the annual examinations of the Third and Fourth Years, provided always that the student obtains honour standing in the examinations of the Fourth Year. Receipt of the medal does not preclude a student from being granted such other award as may in the opinion of the Council be appropriate.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by the late Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of the annual income from the fund is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance. When regulations do not permit the winner to hold this scholarship the students to be considered for the award shall be the first three in the year exclusive of any student who holds a scholarship of higher value.

ALLIED CHEMICAL CANADA LIMITED SCHOLARSHIP

Allied Chemical Canada Limited has presented a scholarship of the value of tuition fees plus $250.00 to the student and a grant of $250.00 to the University, to be awarded to a student registered in the Fourth Year

of the course in Chemical Engineering who has attained honour standing in the examinations of the Third Year. The recipient must be a Canadian or an American citizen and must not already be receiving other awards exceeding $250.00.

AMERICAN SOCIETY FOR METALS FOUNDATION FOR EDUCATION AND RESEARCH SCHOLARSHIP

The American Society for Metals Foundation for Education and Research has donated $500.00 annually since 1953 to provide a Scholarship in the Faculty of Applied Science and Engineering.

The winner must:

(a) obtain the highest average percentage of marks at the examinations of the First Year in Metallurgical Engineering;

(b) register in the Second Year of the course.

This scholarship is not tenable with other awards in the gift of the Senate.

ONTARIO CHAPTER, AMERICAN SOCIETY FOR METALS BURSARY

The Ontario Chapter, American Society for Metals provides a bursary of $400.00 for a student entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than 1st September. The first award will be made for the Session 1958–59.

ARDAGH SCHOLARSHIP

The Ardagh Scholarship, of the annual value of the income from $5,000, has been provided in memory of his parents by Professor E. G. R. Ardagh, B.A.Sc., F.R.S.C., formerly professor of Applied Chemistry in the Faculty. It is awarded to the student who attains the highest standing in Honours at the annual examinations of the Second Year in the Course in Chemical Engineering. The first award was made on the results of the annual examination of 1946.

ATKINSON INCOURSE BURSARIES

Atkinson Incourse Bursaries, gift of the Atkinson Charitable Foundation, are awarded annually to students in the second or higher years of their courses. Applicants must have at least Second Class Honours in the final examinations of the preceding year, demonstrate financial need and be a resident of the Province of Ontario.

Applications must be submitted to the Registrar of the University on or before December 1st.

ATA TRUCKING INDUSTRY EDUCATIONAL FOUNDATION BURSARIES

The Automotive Transport Association of Ontario has established a bursary fund for students in the second or higher years of any undergraduate degree course. Applications may be submitted to the University Registrar at any time during the session and the number and value of the bursaries will vary at the discretion of the Committee of Award.

THE BABB BURSARY FUND

Bursaries from this fund are available to students in any year of the Aeronautics Option in Engineering Physics. Application is made through the Secretary of the Faculty.

THE F. W. BALDWIN PRIZE

The F. W. Baldwin Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44), in memory of Frederick Walker "Casey" Baldwin, a graduate of the School of Practical Science, who made a significant contribution in the field of Aeronautics in Canada; and who flew, on March 12th, 1908, near Hammondsport, N.Y., the "Redwing," the first biplane built by the Aerial Experiment Association.

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in the annual examinations of Third Year in "structural subjects."

The first award was made on the results of the examinations of the Session 1953–54.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that a scholarship of one half the annual income shall be awarded annually to an engineering student on the record of the First Year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship, up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the annual examinations of the First Year, enrolled in any one of the courses of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those courses. The first award was made on the results of the annual examinations of the Session 1925–26.

CANADIAN BECHTEL LIMITED BURSARIES

Canadian Bechtel Limited has established Bursaries in the Faculty of Applied Science and Engineering to the annual amount of $1200. There will be two or more awards, each a minimum value of $100 or a maximum of $600 and are open to students registered in any year who demonstrate financial need and obtain academic standing satisfactory to the Council of the Faculty.

Application should be made to the Secretary of the Faculty before October 15th.

J. P. BICKELL FOUNDATION SCHOLARSHIPS

The Trustees of the J. P. Bickell Foundation have established in the Faculty of Arts and the Faculty of Applied Science and Engineering at least seven scholarships for students entering the First Year, of a possible value of Twelve Hundred Dollars each, payable Six Hundred Dollars in the First Year, and provided honours are obtained at the annual

examinations, Four Hundred Dollars in the Second Year and Two Hundred Dollars in the Third Year.

An applicant must obtain an average of at least 75% at the Ontario Grade XIII examinations immediately preceding his admission to the University on the subjects required for the course of his choice. He must undertake to register in Mining Engineering, Metallurgical Engineering, Applied Geology or Engineering Physics in the Faculty of Applied Science and Engineering *or* in Honour Science, or Mathematics, Physics and Chemistry in the Faculty of Arts. The applicant enrolled in the Faculty of Arts must state his intention of proceeding with the study of mining or geology in the higher years of his course.

Applications must be submitted to the J. P. Bickell Foundation, c/o National Trust Company, Limited, 20 King Street East, Toronto, on or before May 1st on forms to be obtained from the Foundation.

Ten scholarships are available for the Session 1960–61.

The first awards were made for the Session 1952–53.

J. P. BICKELL FOUNDATION BURSARIES

The Trustees of the J. P. Bickell Foundation have established the J. P. Bickell Foundation Bursaries in the Faculty of Arts and the Faculty of Applied Science and Engineering. An applicant must be enrolled in Honour Science or in Mathematics, Physics and Chemistry in the Faculty of Arts, in which case he must undertake to study mining or geology in his higher years; or be enrolled in a higher year of an honour course in the geological or geophysical field in the Faculty of Arts; or be enrolled in Mining Engineering, Metallurgical Engineering, Engineering Physics and Applied Geology in any year of the Faculty of Applied Science and Engineering. He must demonstrate financial need and have satisfactory academic standing.

Application must be made to the Registrar of the University on a form provided by him.

THE T. H. BICKLE PRIZE

The T. H. Bickle Prize is the gift of Mr. and Mrs. E. W. Bickle in memory of their son, T. H. Bickle, an undergraduate of Trinity College and a member of the Senior Intercollegiate Swimming Team at the time of his death in 1937. The income from the endowment fund will be used to purchase a suitable prize to be awarded annually to a member of the Senior Intercollegiate Swimming Team of this University in any year, faculty or school. The Committee of Award shall consist of the Dean of the Faculty of Arts, the University Registrar, the Director of Athletics, and the Honorary Coach of Swimming. In awarding the Prize the Committee shall consider the character, scholarship, and general interests of the members of the team.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a scholarship in the Course in Mechanical Engineering of the value of

One Hundred and Fifty Dollars to the student who obtains highest honour standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Chief Accountant to the fees of the Fourth Year of the successful candidate.

CALIFORNIA STANDARD COMPANY SCHOLARSHIP

The California Standard Company has presented a scholarship of $400.00 to a student who achieves outstanding results in the annual examinations of the Third Year in the Geophysics Option in Engineering Physics or in Applied Geology in the Faculty of Applied Science and Engineering or achieves the highest standing at the annual examinations of the Third Year in Physics and Geology or Geological Sciences in the Faculty of Arts and Science.

The awards alternate annually between the Faculties of Applied Science and Engineering and Arts and Science and the First award will be made in the session 1960–61 in the Faculty of Applied Science and Engineering.

CHEMICAL INSTITUTE OF CANADA PRIZE

The Chemical Institute of Canada offers a prize of the annual value of $25.00 in books to the student registered in the course in Chemical Engineering who, having obtained honours, receives the highest standing in the written and laboratory work of the Third Year.

The first award was made on the results of the final examinations of 1947.

ARCHIE B. CREALOCK MEMORIAL PRIZE

The Archie B. Crealock Memorial Prize is the gift of Mrs. Archie B. Crealock, in memory of her husband, an eminent bridge engineer and a graduate of the Faculty of Applied Science and Engineering of the University of Toronto. It is offered annually to the student of the Third Year in the Course in Civil Engineering, who, having obtained honours in that year, is deemed to be the most worthy of the award. The award is made primarily on the basis of academic standing in the structural subjects of the Year, but extra-curricular activities are also taken into consideration. The Prize consists of engineering books to the value of Fifty Dollars. The award will not necessarily be made in any year.

DOMINION MAGNESIUM LIMITED BURSARY

Dominion Magnesium Limited provides a bursary of $400.00 for a student entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than 1st September. The first award was made in the Session 1958–59.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "A"

These Bursaries are available to students whose parents are resident in Ontario, who are entering the First Year of University, and who are in financial need. Application is made not later than May 1st, through the Principal of the secondary school which the student is attending.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "B"

Under this programme, Bursaries may be awarded to students in financial need who are resident in Ontario and who are in attendance at the University of Toronto. To be eligible, students must have obtained not less than sixty-six per cent. at their last annual examination. Further information may be obtained from the Secretary of the Faculty.

DOW CHEMICAL OF CANADA LIMITED AWARD

Dow Chemical of Canada Limited have provided funds for an annual award of $500.00 to a student in Chemical Engineering in the Faculty of Applied Science and Engineering, and a grant-in-aid of $250.00 to be used in the winner's department to help defray the cost of equipment, supplies and administration.

The winner must:

(a) be registered in the Third Year in Chemical Engineering (the award will be made in the second term of the Third Year and will be paid to the winner during his Fourth Year)

(b) be in the upper half of the class

(c) have demonstrated leadership in extra-curricular activities.

The award is not tenable with other awards in the gift of the Senate. Application is not required.

THE ELECTRICAL MANUFACTURING COMPANY LIMITED PRIZE

The Electrical Manufacturing Company Limited has established an annual Prize of $25.00 in the Faculty of Applied Science and Engineering.

The winner must:

(a) be registered in the Fourth Year in Electrical Engineering

(b) obtain the highest aggregate percentage of marks at the final examinations in the subjects of the Fourth Year related to electrical distribution equipment, the subject to be determined by the Head of the Department of Electrical Engineering.

This prize is tenable with other awards in the gift of the Senate.

THE JOHN M. EMPEY SCHOLARSHIPS

The John M. Empey Scholarship Fund was established under a bequest of $10,000 in the Will of the late John Morgan Empey, B.A.Sc., 1903. Three scholarships of equal value are provided from the income

from the Fund. One of these scholarships is awarded in each of the First, Second, and Third Years on the results of the annual examinations, to a student who, taking honours, obtains the highest average percentage of marks in the written and laboratory subjects of his Year. The scholarships are open to any students registered in the Faculty. In case the winner of any one of these scholarships does not attend this Faculty during the session next following the award, the right to the scholarship shall be forfeited and the award shall be made to another eligible student. The scholarships were awarded for the first time in 1944.

ENGINEERING ALUMNI ADMISSION BURSARIES

The Engineering Alumni Association has made up to a maximum of fifteen bursaries of $600 each available annually. Applicants must be residents of Ontario, register in the First Year of the Faculty of Applied Science and Engineering, and need financial assistance.

Applicants should consult their secondary school Principal for details. Further information may be obtained from the Chairman, Engineering Alumni Education Committee, Faculty of Applied Science and Engineering, University of Toronto.

ENGINEERING ALUMNI ADMISSION SCHOLARSHIP

The Engineering Alumni Admission Scholarship, the gift of the Engineering Alumni Association, of the value of $500, is awarded on the recommendation of the Council of the Faculty to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Fifty Dollars in this University, commencing 1931, to the student who, in his Third Year in any one of the six courses of Engineering, has proved himself most deserving as disclosed by the examination results of the year, in combination with his activities in the Engineering Society or with a local branch of another recognized engineering organization.

ENGINEERING SOCIETY SEMI-CENTENNIAL AWARD

The Engineering Society Semi-Centennial Award, to the value of Seventy-five Dollars, was established in 1931 to commemorate the semi-centennial of the founding of the "School". The award is made to a student entering the final year.

The selection is based upon the following qualifications, which bear equal weight in the selection of the winner: (*a*) General "School" activities. (*b*) Contributions to the Engineering Society Executive Committee. (*c*) Personality, and social and athletic activities. (*d*) Academic standing.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available, each of a value of one half of the income of the fund, to students in this Course, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession, and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award shall be made to another eligible student.

HUGH GALL AWARD

The Hugh Gall Award, of the annual value of One Hundred and Forty Dollars, the gift of the Graduate Class of 1910, "to commemorate a deceased classmate who was a splendid type of student, a loyal friend, and nationally outstanding in athletic achievement during his undergraduate career", was established in 1946 for a five year period and, through the generosity of Mrs. Hugh Gall extended for a further three year period. It is awarded to a student, who, having completed his First Year with a general average of at least 66% without conditions, has entered the Second Year, and is in special need of financial assistance in order to enable him to continue his course. It is desirable, but not necessary, that the recipient shall not already have been given any other scholastic award or scholarship applicable to the Second Year and he shall have shown indications of his firm intention and ability to follow successfully the profession of engineering.

Any second year student in the Faculty of Applied Science and Engineering is eligible to apply for this Bursary. Applications should be made to the Secretary of the Faculty not later than one month after the opening of the session.

THE REGINALD AND GALER HAGARTY SCHOLARSHIP

The Reginald and Galer Hagarty Scholarship, in memory of the dearly beloved sons of Lieutenant-Colonel E. W. Hagarty, B.A. 1883, M.A. 1908, and Charlotte Ellen Hagarty, his wife. Reginald Edward Walter Hagarty, B.A.Sc. (Honours) 1908, a graduate of the University in the Faculty of Applied Science and Engineering and at the time of his death on April 29, 1925, a Consulting Structural Engineer. Lieutenant Daniel Galer Hagarty, Princess Patricia's Canadian Light Infantry, a member of the class of 1916 in Applied Science, enlisted for the Great War at the end of his third year in June, 1915, killed in action in Sanctuary Wood, June 2, 1916. The scholarship is given in recognition of the fact that their father was an honour graduate in Classics of the University of Toronto. It is of the value of the annual interest on the capital sum of $2000.00 and is to be awarded to a student who has been enrolled for his Grade XIII Year at Harbord Collegiate Institute and having obtained at least the required standing in each of the Grade XIII subjects necessary for admission to the Faculty, obtains the highest standing in English, a language other than English, and Mathematics, among the students who apply for the award from the Collegiate. He will be required to: (*a*) register in the Faculty of Applied Science and Engineering, (*b*) sign a declaration to the effect that he is willing to take up arms in the defence of Canada and the British Commonwealth should necessity arise as declared by the Parliament of Canada. The Scholarship was offered for award for the first time in 1945. Application should be made to the Registrar of the University.

CHESTER B. HAMILTON SCHOLARSHIP

Members of the family of the late Chester B. Hamilton, a graduate of this Faculty in 1906, have presented a Scholarship in his memory of the annual value of $500.00. It is held by a Fourth Year student in Mechanical Engineering who has achieved outstanding academic standing at the Annual Examinations of the Third Year.

The first award was made on the results of the examinations for the Session 1958–59.

HEATING AND AIR CONDITIONING ENGINEERS PRIZE

The Ontario Chapter of the American Society of Heating and Air Conditioning Engineers offers an annual prize of Seventy-five Dollars, first awarded in 1931, for a period of five years, and extended indefinitely in 1935. The prize will be awarded to a student in either the Third or Fourth Year in any Course of the Faculty who, in the opinion of the Department of Mechanical Engineering, has written the most satisfactory thesis on a subject dealing with heating or ventilation, such thesis being prepared under special arrangements made by the Department of Mechanical Engineering, the result to be reported to the Council with the annual examination results. The thesis must be handed in

not later than March 1st. The prize will not necessarily be awarded in any year.

Application should be made to the Department of Mechanical Engineering.

HUDSON BAY MINING AND SMELTING COMPANY LIMITED SCHOLARSHIPS

The Hudson Bay Mining and Smelting Company Limited awards Scholarships to students who have obtained their Senior Matriculation at the High Schools in Flin Flon, Manitoba, and its environs. These Scholarships, having a value of $800.00 each annually, may be held in the Third and Fourth Years in this Faculty, in the Course in Chemical Engineering, Metallurgical Engineering, Mining Engineering, and Applied Geology. Application should be made to the Company.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO SCHOLARSHIPS IN ENGINEERING

The Hydro-Electric Power Commission of Ontario has presented three scholarships in Engineering, each of a value of $300.00 to be awarded to three students selected from among the higher ranking students in the annual examinations of the First, Second, and Third Years in any course in the Faculty, one scholarship in each year to be tenable in the Second, Third and Fourth Years respectively.

The first award was made at the annual examinations in April, 1952.

THE INCO SCHOLARSHIP

The International Nickel Co. of Canada Limited has established a Scholarship for students entering the University. Each Scholarship provides for tuition fees plus $300.00 and may be continued throughout a four-year course if satisfactory standing is maintained.

To be eligible for consideration the applicant must obtain an average of 75% or over in the Ontario Grade XIII subjects required for admission to his course and demonstrate financial need.

Application must be made to the Registrar of the University by May 1st on the regular scholarship application form.

JENKINS SCHOLARSHIP

The Jenkins Scholarship, presented by Jenkins Bros., Limited, Montreal, first awarded in 1925, has been donated to continue indefinitely.

This Annual Scholarship, of the value of Two Hundred Dollars, is awarded to the student of the Third Year registered in any course of the Faculty who has the highest aggregate of percentages for the First, Second, and Third Years.

JOHNSON'S WAX SCHOLARSHIP

S. C. Johnson and Son Limited, Brantford, Ontario, have established a Scholarship of an annual value of $600 in each of the Second, Third and Fourth Years or a total possible value of $1800.

The recipient must:

(*a*) be registered in Chemical Engineering in the years in which the Scholarship is awarded and held;

(*b*) in the opinion of the Council be the most promising and deserving member of the class, obtaining Honours in the final examinations of the First Year;

(*c*) in his Second and Third Years, maintain academic standing satisfactory to the Council, not necessarily Honours, for the continued enjoyment of the Scholarship.

In its discretion the Council may recommend the award of any portion of the Scholarship, lost by the original recipient by failure to maintain satisfactory academic standing, to another student of the year(s) in which the Scholarship would otherwise have been enjoyed.

The first award was made on the results of the annual examinations written in April 1954. It is not tenable with any other Scholarship.

KIMBERLY-CLARK CORPORATION OF CANADA LIMITED SCHOLARSHIPS

Kimberly-Clark Corporation of Canada Limited has presented two scholarships of a value of $500.00 each and each scholarship is accompanied by a grant of $100.00 to the general funds of the University. The Scholarships are awarded on the annual examinations of the First and Second Years and one scholarship is awarded to an outstanding student of the First Year and one to an outstanding student of the Second Year as indicated by the examination results of their respective years. Students in all courses of the First and Second Years are eligible.

The First awards were made on the results of the annual examinations for 1957–58.

THE LEVER BROTHERS SCHOLARSHIPS

Lever Brothers Limited have established two Scholarships of $300.00 each in the Department of Chemical Engineering. The Scholarships will be awarded to a student of the Second Year and to a student of the Third Year in Chemical Engineering to be held in the Third and Fourth Years respectively. The award is based on outstanding scholarship at the annual examinations.

The first awards were based on the annual examinations of 1957.

THE LEONARD FOUNDATION SCHOLARSHIPS

Leonard Foundation Scholarships are awarded each year to selected students in Universities and Colleges across Canada, including the University of Toronto. The Trust Deed states: "Preference in the selection of students for scholarships shall be given to the sons and daughters respectively of the following: (*a*) clergymen, (*b*) school teachers, (*c*) officers, non-commissioned officers and men, whether active or retired, who have served in His Majesty's military, naval or air forces, (*d*) graduates of the Royal Military College of Canada, (*e*) members of the Engineering Institute of Canada, (*f*) members of the Mining and Metallurgical Institute of Canada."

All applicants must be nominated by a member of the General Committee. The latest date for the receiving of applications is March 31st, for the following academic year. Further information regarding the procedure to be followed in applying for these scholarships may be obtained by writing to Dr. W. E. Taylor, Honorary Secretary, The Leonard Foundation, c/o Toronto General Trusts Corporation, 253 Bay Street, Toronto.

THE JOHN WOLFE MCCOLL MEMORIAL AWARDS

These six awards, two of which are open to students in the Faculty of Applied Science and Engineering, are the gift of the estate of the late John Wolfe McColl. The awards have a minimum value of $250.00 and a maximum of $750.00. Applicants must have obtained First Class Honours at the final examinations of the preceding year, whether Ontario Grade XIII or at the University of Toronto, demonstrate financial need and be enrolled or undertake to enrol in either Engineering Physics or Chemical Engineering. Students seeking first admission to the University must submit applications for an award to the Registrar of the University on or before May 1st. Students in the University must submit applications for an award to the Registrar of the University on or before September 1st.

THE J. A. D. MCCURDY PRIZE

The J. A. D. McCurdy Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44) in honour of John Alexander Douglas McCurdy, a graduate of the School of Practical Science, who "made the first flight in Canada on February 23rd, 1909, with a heavier-than-air machine."

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in annual examinations of the Third Year in the subjects related to Aerodynamics.

The first award was made on the results of the examinations of the Session 1953–54.

THE GARNET W. MCKEE-LACHLAN GILCHRIST SCHOLARSHIP IN ENGINEERING PHYSICS

Mrs. Garnet W. McKee and Professor Lachlan Gilchrist each contributed $1000.00 to provide for a Scholarship in the First Year of the Course in Engineering Physics. The value of the Scholarship is the annual income from the capital fund and is awarded to the student who ranks first in honours at the annual examinations of the First Year in the Course in Engineering Physics. If for any reason that student is ineligible to hold the Scholarship, it will be awarded by reversion to the student ranking second in honours in the Course. In order to receive payment the winner must register in the Second Year of the Course in Engineering Physics. The Scholarship was awarded for the first time on the results of the annual examinations of 1947.

THE GARNET W. MCKEE-LACHLAN GILCHRIST GEOPHYSICS SCHOLARSHIPS

Financial assistance was received by Professor Lachlan Gilchrist of the Department of Physics, University of Toronto, from certain organizations and individuals to help him in the prosecution of his research work in Geophysics. With the consent of the contributors, the unexpended balance of these gifts was transferred by Professor Gilchrist to the Board of Governors of the University to be used as an endowment for scholarships, two of which were established in the Faculty of Applied Science and Engineering. To this fund have been added additional amounts received from the estate of the late Garnet W. McKee and from the Hollinger Consolidated Gold Mines Ltd. They are awarded by the Senate, on the recommendation of the Council of the Faculty of Applied Science and Engineering. The first awards were made on the results of the Annual Examinations of 1941.

The First Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $4,000.00, is awarded to the student in the Second Year in the Course of Engineering Physics who obtains the highest aggregate standing at the examinations of the First and Second Years in the Course, provided always that the student obtains honour standing at the examinations of the Second Year.

The Second Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $3,000.00 is awarded to the student in the Second Year in the Course of Engineering Physics who, of those students who elect to proceed in the Third Year in the Geophysics Option of the Course, obtains the highest aggregate standing at the examinations of the First and Second Years, provided always that the student obtains honour standing at the examinations of the Second Year, and excluding always the student to whom the First Lachlan Gilchrist Geophysics Scholarship has been awarded.

If in any year there is no student who has fulfilled the conditions as laid down for the Second Lachlan Gilchrist Geophysics Scholarship, it shall be awarded to the student in the Second Year in the Course in Engineering Physics who obtains the second highest aggregate standing at the examinations of the First and Second Years of that Course, provided always that such student obtains honour standing in the examinations of the Second Year.

THE ALEXANDER MACLEAN SCHOLARSHIP

This scholarship was established by graduates of the University of Toronto and other friends in honour of Professor Alexander MacLean, B.A. (1908) who retired in 1954. The scholarship, of the value of $250, is awarded to a student in the Third Year of Geological Sciences, Faculty of Arts, or in the Third Year of Applied Geology, Faculty of Applied Science and Engineering, who, obtaining not less than 75% in the work of the year, obtains the highest standing in the geological subjects common to the two courses.

The first award was made in 1955.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. If in any year no award is made, a second award will be available in a subsequent year.

CHARLES GORDON MANNING PRIZE

The Charles Gordon Manning Prize was established by a bequest under the Will of the late Jennie Manning in the amount of Five Hundred Dollars ($500), the annual income from which is to be used to buy books for the winner of the Prize.

The recipient must be enrolled in the Second Year of a course offered by the Faculty of Applied Science and Engineering and, in the opinion of the Council, rank second to the student awarded the Harvey Aggett Memorial Scholarship in the considerations specified for the award of that Scholarship, namely, obtaining honours in his final examinations and being one of the first three in his year by his standing at those examinations relative to the pass requirements in his Department and being "adjudged highest of the three in general student activities and service in the University during his period of attendance."

The first award was made on the results of the Annual Examinations of 1954.

MARSLAND ENGINEERING LIMITED SCHOLARSHIP

The Marsland Engineering Limited Scholarship, the gift of Marsland Engineering Limited, has a value of Two Hundred and Fifty Dollars. It is awarded to the student who, having been granted a Dominion-Provincial Student Aid Bursary in his First Year, is registered in Mechanical or Electrical Engineering and obtains the highest average percentage of marks, with honours, at the annual examination of the First, Second or Third Years in the session in which the award is made.

The first award was made at the annual examinations of 1954.

MASSEY-FERGUSON LIMITED SCHOLARSHIPS

Massey-Ferguson Limited has established two scholarships each of an annual value of $250.00, to be awarded on the recommendation of

the Council of the Faculty of Applied Science and Engineering to students registered in the Fourth Year of the Courses in Mechanical Engineering or Engineering and Business. In making the award academic achievement, financial need, extra-curricular activities and such other factors as may be deemed appropriate will be taken into consideration.

Application should be made to the Secretary of the Faculty not later than 15th October.

THE W. G. MILLAR MEMORIAL SCHOLARSHIP

The W. G. Millar Memorial Scholarship is presented by Marsh and McLennan, Limited, of an annual value of $250.00, in memory of the late Mr. W. G. Millar, a member of the Class of 1914 in Civil Engineering. The Scholarship will be awarded to a student entering the Third Year in Mining Engineering, on the recommendation of the Head of the Department of Mining Engineering.

The award will be made on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

MOBIL OIL OF CANADA, LIMITED, SCHOLARSHIP

Mobil Oil of Canada Limited has donated a scholarship of the annual value of $400.00, tenable in the graduating year of either Geological Sciences, Faculty of Arts or Applied Geology, Faculty of Applied Science and Engineering. The award is based on academic performance in the first three years. Good character, personality, breadth of influence, initiative, willingness to assume responsibility and ability to co-operate with associates may be taken into consideration.

Application is not required.

JAMES L. MORRIS MEMORIAL PRIZE

The James L. Morris Memorial Prize is the gift of Mrs. J. H. Craig and Mr. J. R. Morris, K.C., in memory of their father, James L. Morris, C.E., O.L.S., D.Eng., the first graduate of the School of Practical Science, who died in 1946 after a distinguished career. Graduating in Civil Engineering in 1881 as the sole member of his class, Dr. Morris engaged in railway work for some time, first as an engineer and then as a contractor. For 43 years he conducted a successful civil engineering practice in Pembroke, Ontario, involving important undertakings in the field of municipal, power and bridge work.

This Prize, of the value of the annual income from $3,000.00, is awarded annually to the student in the Second Year in the Course in

Civil Engineering who obtains the highest aggregate percentage at the annual examinations of the First and Second Years of the course, provided always that the student obtains honour standing at the Examinations of the Second Year.

SPRUCE FALLS POWER AND PAPER COMPANY LIMITED SCHOLARSHIPS

The Spruce Falls Power and Paper Company Limited has established four Scholarships of a value of $400.00 each, two in the Second Year and two in the Third Year. They are awarded on the results of the Annual Examinations of the Second and Third Years to the students who obtain honour standing at the examinations of their respective years and are open to students in all courses in the Faculty. The first awards were made on the results of the examinations of 1951.

Each scholarship carries a grant of $150 to the University General Funds.

NORTHERN ELECTRIC UNDERGRADUATE SCHOLARSHIP

The Northern Electric Company Limited have established a Scholarship in the Faculty of Applied Science and Engineering and the Faculty of Arts of an annual value of $500.00. In this Faculty the scholar must be registered in the Second or Third Year of Electrical Engineering, Mechanical Engineering, Engineering Physics or Engineering and Business. He must also (a) be a Canadian citizen or landed immigrant and (b) have a minimum of 75% or its equivalent in the previous annual examinations, in this or another recognized University.

The award is made alternately in the two faculties, the first in the Faculty of Arts in 1959 and in the Faculty of Applied Science and Engineering in 1960 and in a similar manner thereafter. Application is not required.

THE ONTARIO HOCKEY ASSOCIATION WAR MEMORIAL SCHOLARSHIP

The Ontario Hockey Association War Memorial Scholarship, the gift of the Ontario Hockey Association, is to be awarded annually at the Grade XIII examination to a man student who has served overseas with the Canadian forces, or to a student who is the son or daughter of one who has so served.

The value of this scholarship is $100 in cash, with an allowance of the same amount on the tuition fee for each session.

In determining the award of the scholarship, the academic qualifications of the candidate shall be first taken into account, provided always that no candidate shall be eligible for an award who has not met all the conditions required by the University of candidates for admission scholarships generally; but, *cœteris paribus*, the award shall be made to a student who is in proved need of assistance.

The award shall be made by the Senate of the University upon the report of a committee to be appointed by the Senate, upon which committee there shall be always one member of the Staff of the University who shall be deemed to be the representative of the Association.

Candidate shall make application not later than May 1st on the special form to be obtained from the Registrar of the University.

ONTARIO MUNICIPAL ELECTRIC ASSOCIATION BURSARY

District No. 4 of the Ontario Municipal Electric Association has provided a Bursary of $300.00 in the Faculty of Applied Science and Engineering.

An applicant for the Bursary must:

(a) be registered in the Four Year, Electrical Engineering
(b) have good academic standing
(c) be in need of financial assistance

Application should be made to the Secretary of the Faculty not later than October 15th.

ORENDA ENGINES SCHOLARSHIPS

Orenda Engines Limited have donated three scholarships each of a value of Five Hundred Dollars, awarded annually to students completing the First, Second and Third Years respectively in courses other than Mining Engineering and Applied Geology. These scholarships are awarded to students with high academic standing and in cases of close competition, preference will be given to the student who indicates that he possesses initiative and leadership qualities and that he will be a credit to his profession after graduation.

This award may be held with other awards provided that the monetary value of the other awards does not exceed One Hundred Dollars. The first award was made in the Session 1955–56.

PAULIN MEMORIAL SCHOLARSHIP

The Paulin Memorial Scholarship, provided through the generosity of the late Mr. Fred W. Paulin, a graduate of the Faculty in 1907, was established in memory of his brother, John Cameron Paulin, a student in Mining Engineering, who was fatally injured in 1906 during a football practice. The Scholarship which has a value of $425.00, is awarded on the recommendation of the Department of Mining Engineering to a student registered in Mining Engineering, who has successfully completed the work of the First Year.

The award is made on the following bases:

(*a*) academic proficiency.

(*b*) qualities necessary for the development of leadership, such as ambition, initiative, resourcefulness and strength of character.

(*c*) he must continue his studies in Mining Engineering during the following session.

The first award was made for the Session 1951–52.

PROCTER AND GAMBLE BURSARY PLAN

Procter and Gamble Bursaries, the gift of the Procter and Gamble Company of Canada, are awarded annually to students in all years. Applicants must have at least Second Class Honours or better in the final examinations of the preceding year and demonstrate financial need. Applications must be submitted to the Registrar of the University on or before December 1st.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO ADMISSION SCHOLARSHIP

The Association of Professional Engineers of the Province of Ontario has established an Admission Scholarship in Engineering of the value of $500.00, awarded for the Session 1953–54 at Queen's University and for the Session 1954–55 at the University of Toronto and thereafter alternately at each University. It is awarded by the Senate on the recommendation of the Council of the Faculty of Applied Science and Engineering to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Successive awards will be made in 1956 and every second year thereafter. Application must be made to the Registrar before May 1st.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO SCHOLARSHIPS

The Association of Professional Engineers of the Province of Ontario offers Scholarships of a value of $250.00 in each of the First, Second and Third Years in the Faculty of Applied Science and Engineering in any course, to the students who, taking Honours, obtain the highest standing in the work of their respective years.

These scholarships will not be awarded to students who hold other scholarships.

PROFESSIONAL ENGINEERS GOLD MEDAL

The Association of Professional Engineers of the Province of Ontario has established in the Faculty of Applied Science and Engineering an award in the form of a gold medal accompanied by a gift of technical

books of an approximate value of fifty dollars. The award will be made to the student of the final undergraduate year in any course who, taking honours, obtains the highest weighted average percentage in the practical work and written examinations of the year.

RANSOM SCHOLARSHIP IN CHEMICAL ENGINEERING

The Ransom Scholarship in Chemical Engineering is presented by A. C. Ransom, Esq., of Toronto, for the purpose of encouraging and giving financial assistance to students who choose the field of Chemical Engineering. This donation, consisting of $5,000, provides for a perpetual scholarship of an annual amount such as will be derived from the income of this sum. The first award was made on the results of the annual examinations of 1938.

The scholarship will be awarded annually to the student registered in the Course in Chemical Engineering who obtains the highest aggregate percentage of marks in the examinations of the First Year. The scholarship will be paid to the winner only if he proceeds to take his Second Year in the Course in Chemical Engineering in the University of Toronto.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer for award in the Province of Ontario two out of ten of the Rhodes Scholarships for Canadians, each of the basic value of £400 a year but temporarily increased to £500. They are tenable ordinarily for two years at the University of Oxford. A third year given conditionally at Oxford or elsewhere abroad may be authorized in proper cases.

Each candidate must be a British subject with at least five years domicile in Canada and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year *for* which he is elected; he must have completed the first year and have entered upon the second year of his course at a Canadian university at the time of application.

A candidate may apply either for the province in which he has his private home or residence, or for the province in which he has taken his university course.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;
(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;
(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;
(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Some definite quality of distinction, whether in intellect, character or personality, or in any combination of these, is the most important requirement. Financial need does not receive special consideration.

Forms of application and full information regarding these scholarships may be obtained from D. R. Michener, Esq., Q.C., 5 Rosedale Road, Toronto 5, General Secretary for the Rhodes Scholarships in Canada or from A. B. Harvey, Esq., Q.C., c/o Law Society of Upper Canada, Osgoode Hall, secretary of the Ontario Selection Committee, or from the University Registrar. Selection is made in December each year for the scholarships for the year following. Application must be made to Mr. Harvey or the appropriate provincial secretary on or before November 1st.

R.C.E. MEMORIAL SCHOLARSHIP

The Memorial Fund Committee of the Royal Canadian Engineers has established the R.C.E. Memorial Scholarship of a value of One Hundred and Twenty-five Dollars, open to students who have successfully completed their second to last year in the Faculty of Applied Science and Engineering or the School of Architecture.

A candidate must be

(a) a member in good standing of the Canadian Officers Training Corps and have successfully completed one summer season's training

or

(b) an ex-member of the Canadian Officers Training Corps who has successfully completed his three years of C.O.T.C. training

or

(c) a member of the Canadian Army (Regular) attending University under the Regular Officers Training Plan.

Selection is made on the basis of academic standing and of qualities of leadership.

Application forms may be obtained at the C.O.T.C. Orderly Room, 119 St. George St.

FREDERICK W. SCHUMACHER SCHOLARSHIP

The Frederick W. Schumacher Scholarship has been established in the Faculty of Applied Science and Engineering and in the Faculty of Arts under a bequest of the late Frederick W. Schumacher. It has a value of the income from the fund. The scholar must (a) be enrolled in the Second, Third or Fourth years in Mining Engineering or Applied Geology in the Faculty of Applied Science and Engineering or in Physics and Geology or Geological Sciences in the Faculty of Arts and (b) must have high academic standing.

Applications must be submitted to the University Registrar not later than October 15th.

THE SCOTTISH RITE MASONS' BURSARY

The Scottish Rite Masons' Bursary, the gift of the Scottish Rite Masons of Toronto, of the value of $200 is awarded to a student enrolled

in the Second Year who is a member of the Masonic Order, or a son, brother, nephew, daughter, sister or niece of a member of the Masonic Order. Consideration will be given to financial need and academic standing. Evidence of connection with the Masonic Order and information regarding financial need must be given with the application which must be submitted to the Secretary of the Faculty.

"SECOND MILE ENGINEER" AWARD

Inspired by an address of President William E. Wickenden of Case School of Applied Science, Cleveland, called "The Second Mile", which was based on the text from the Sermon on the Mount, "whosoever shall compel thee to go one mile, go with him twain", the Class of 1935 has established the "Second Mile Engineer" Award. It is the desire of the donors to encourage students to participate in activities outside the confines of their technical training and to interest themselves in the more liberal subjects of the curriculum. The value of the award is $100.00 and is given to a student in his final year.

An eligible group is chosen from those who have taken a prominent part in the affairs of the Faculty, either as office holders or in athletics. In making the award consideration is given to academic standing, with special emphasis on the candidate's attainments in the cultural and humanistic-social studies. The subjects which are stressed are English and Political Science of the First Year; Economics of the Second Year; and Modern World History of the Third Year.

Particulars are furnished each session by the Class of 1935.

THE SIMPSON-SEARS LIMITED (NORTHERN ONTARIO) SCHOLARSHIPS

These scholarships, the gift of Simpson-Sears Limited, are open only to students of the Copper Cliff High School, The Sudbury High and Technical Schools, the Sturgeon Falls High School, the North Bay Collegiate Institute and Vocational School, the Kapuskasing High School and all the Secondary Schools along the Ontario Northland Railway. A scholarship of the value of $100 is available for each of the schools mentioned and an additional sum of $50 will be given to the student who obtains the highest percentage of the nine papers of Grade XIII selected in accordance with the regulations.

No scholarship will be awarded unless the candidate is in actual attendance in one of the colleges or faculties of the University and maintains a uniformly high standard to the satisfaction of the donors of the scholarships.

Application for these scholarships must be sent not later than May 15th, to the Principal of the North Bay Collegiate Institute and Vocational School, from whom further information may be obtained regarding conditions of award.

SMITH AND STONE LIMITED BURSARIES

Smith and Stone Limited, Georgetown, Ontario, have provided five Bursaries, each of a possible value of $600 and each payable at the rate

of $150 per year to assist deserving students from the Georgetown High School.

The award is made annually by the Senate on the recommendation of the Council of the Faculty to a student:

(*a*) who attended Georgetown High School for at least 2 years and is recommended by the Principal;

(*b*) who has met in full the admission requirements of the Faculty, first class honours not being a requirement.

To be eligible for continued enjoyment of the Bursary the holder must maintain satisfactory academic standing but not required to obtain honour standing.

The award was offered for the first time in the Session 1952–53.

THE WILLIAM STORRIE MEMORIAL SCHOLARSHIPS IN CIVIL ENGINEERING

Three Scholarships have been established by Mrs. William Storrie in memory of her husband, the late William Storrie, a Consulting Engineer on many municipal projects in Canada and for several years a special lecturer in the Faculty of Applied Science and Engineering, for students in Civil Engineering, as follows:

(a) Of a value of $100.00 to the student completing his Second Year in Civil Engineering with the highest aggregate standing in the subjects of Calculus, Engineering Chemistry, Mechanics of Materials, and Surveying.

(b) Of a value of $100.00 to the student completing his Third Year in Civil Engineering with the highest aggregate standing in the subjects of Cements and Concrete, Structural Engineering, Engineering Problems and Drawing, and Hydraulics.

(c) Of a value of $200.00 to the student completing his Fourth Year in Civil Engineering with the highest aggregate standing in the subjects of Hydraulics, Municipal Administration and Contracts, Sanitary Engineering, and Thesis and Public Speaking.

In all cases the candidates shall have demonstrated qualities of integrity and shown promise of leadership in their profession.

The first awards were made for the Session 1956–57.

STUDENTS' ADMINISTRATIVE COUNCIL ADMISSION SCHOLARSHIP

The Students' Administrative Council Admission Scholarship of the annual value of $300, the gift to a student who (*a*) resides within the District of Manitoulin, or within that part of the Province of Ontario which lies north of the forty-sixth parallel of latitude excluding the cities of North Bay, Sudbury, Sault Ste. Marie, Port Arthur and Fort William; (*b*) obtains the highest average standing in first class honours in the nine papers of Grade XIII prescribed for admission to the course which he desires to enter: and (*c*) who enrols in one of the following

faculties: Medicine, Applied Science and Engineering, Forestry, Dentistry, in the School of Architecture, or in the Four-Year Course leading to the degree of Bachelor of Science in Pharmacy.

The scholarship is tenable for two years provided that the holder obtains an average of at least sixty-six per cent. at the annual examinations of the First Year. Application must be made to the University Registrar not later than May 1st.

THE TRANE COMPANY OF CANADA LIMITED PRIZE

The Trane Company of Canada Limited has established an annual Prize of $200.00 in the Faculty of Applied Science and Engineering. The recipient may be registered in the Fourth Year in any course and the Prize will be awarded for the best Thesis on air-conditioning or refrigeration, either for comfort cooling or industrial use.

This award is tenable with other awards in the gift of the Senate. Application is not required.

EDITH TYRRELL MEMORIAL BURSARY

The Women's Association of the Mining Industry of Canada has presented this Bursary, having the value of Five Hundred Dollars, annually, commencing in 1939, and named in memory of their founder and first president, Mrs. Edith Tyrrell. A medal donated by Dr. Tyrrell accompanies the Bursary. The Bursary is awarded to a student entering the Third or Fourth Year in the Course in Mining Engineering, Metallurgical Engineering, or Applied Geology; it may be awarded two years in succession to the same student, but will usually be awarded at the beginning of the Third Year. The award will be made by a special committee appointed by the Association on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

S. UBUKATA FUND

The S. Ubukata Fund for Japanese Students, the gift of the late S. Ubukata, provides for the establishment of scholarships, bursaries, medals, prizes, and loans for students from Japan proper attending the University of Toronto or one of its federated or affiliated colleges. An applicant for a scholarship, bursary or loan must be in good standing and have completed the first year of the work of the faculty or department in which he is registered. An occasional student must obtain a certificate

from the head of the college or dean of the faculty concerned that full time is being devoted to his or her studies. A student is not eligible who is at the time in receipt of aid or support from any other institution, religious or otherwise, in this country or in Japan or who already holds a scholarship or fellowship in the University. Application must be made to the University Registrar on or before December 1st.

UNIVERSITY OF TORONTO ALUMNI ASSOCIATION WAR MEMORIAL SCHOLARSHIPS OR AWARDS

Six scholarships and awards, each of the value of $200.00 will be granted in 1960–61 by the Alumni Association from the War Memorial Scholarship Fund to students registered in the Faculty of Applied Science and Engineering.

The general basis on which scholarships or awards may be granted will be as follows: (*a*) standing in course of studies; (*b*) relationship to active service in the armed forces of Canada; (*c*) need of financial assistance; (*d*) merit shown by participation and interest in extra-curricular undergraduate activities of the University; (*e*) such other qualifications as may commend themselves to the Alumni Association.

Information regarding these scholarships and awards may be obtained from The University of Toronto Alumni Association, 18 Willcocks Street, to whom application must be made before March 1st.

UNIVERSITY NAVAL TRAINING DIVISION BURSARIES

The University Naval Training Division Bursaries, the gift of the University Naval Training Division, are of the value of $100 each. As many as three bursaries may be awarded in each session; if fewer than three are awarded those not awarded may be given in a subsequent session. A candidate must be registered in the University for a full-time course leading to a diploma or degree and must be at the time of the award a member of one of the recognized military training units within the University. Application must be made to the University Registrar before the end of November.

UNIVERSITY OF TORONTO GENERAL BURSARIES

The Board of Governors has established a fund to provide bursaries for deserving students who without financial assistance cannot continue their formal education. Further information may be obtained from the Secretary of the Faculty.

MONTREAL BRANCH—UNIVERSITY OF TORONTO ALUMNI ASSOCIATION BURSARIES

The Montreal Branch of the University of Toronto Alumni Association offers Bursaries to students, undergraduate or graduate from the Montreal area. Apply to the President of the University of Toronto Alumni Association or to Mr. A. L. Stewart, B.A.Sc., 1980 Claremont Avenue, Montreal.

THE U.T.S. ENGINEERING SCHOLARSHIP

The U.T.S. Engineering Scholarship, the gift of R. A. Bryce, Esq., of the value of $250. The scholarship will be awarded by a committee of the Staff of the University of Toronto Schools to a student of the Schools who has completed the requirements for admission to and enrols in the Faculty of Applied Science and Engineering.

WALLBERG ADMISSION SCHOLARSHIPS

Two admission scholarships, each of a value of $500.00 are awarded annually from the income from the Wallberg Bequest on the recommendation of the Council of the Faculty to the two candidates who obtain the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that this attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Applications must be submitted to the Registrar on the prescribed form by May 1st.

WALLBERG UNDERGRADUATE SCHOLARSHIPS

These scholarships, four in number, of the value of $500.00 each, derived from the Wallberg Bequest, are awarded annually; two to students ranking first and second respectively at the annual examinations of the First Year; one to the student ranking first at the annual examinations of the Second Year; and one to the student ranking first at the annual examinations of the Third Year.

Any holder of one of these scholarships may not hold other awards listed in the Calendar with an asterisk. The awards were first made on the result of the annual examination of 1947.

WILLIAM R. WORTHINGTON MEMORIAL SCHOLARSHIP

The William R. Worthington Memorial Scholarship, the gift of Miss Ida R. Worthington, in memory of her brother, William R. Worthington, Dip.(1904), B.A.Sc.(1905), of the value of the income from a fund is awarded annually to the student of the Second Year in the course in Civil Enginering who ranks highest at the anual examinations of that year.

The first award was made at the examinations for the Session 1954–55.

THE ATHLONE FELLOWSHIPS

Her Majesty's Government in the United Kingdom has established a number of fellowships to be awarded annually to enable Canadian engineering graduates to take postgraduate training in the United Kingdom. These became available in 1951 when five fellowships were open to graduates of the University of Toronto immediately after graduation. Additional fellowships are for award to graduates who have already spent some time in industry. The fellowships cover costs of transport, fees and maintenance and are normally tenable for a period of two years. They may be utilized for (*a*) works training in industry, (*b*) postgraduate university study, or (*c*) a combination of these. Candidates must be Canadian citizens or British subjects normally resident in Canada and should preferably be less than 27 years of age. Further information and application forms may be obtained from the Secretary of the Faculty.

THE C.I.L. FELLOWSHIPS

Two Fellowships, the gift of Canadian Industries (1954) Limited, of the value of $2,000 each are established for the encouragement of postgraduate work in Chemistry. An applicant must be a university graduate who is a Canadian citizen or a graduate who intends to follow a career in Canada, with preference to Canadian citizens. The holders of these Fellowships will be required to undertake research in any branch of Chemistry under the direction of the department designated by the Committee of Award. Application must be made, with full statement of qualifications and testimonials, to the Secretary of the School of Graduate Studies not later than March 1st.

CANADIAN LUMBERMEN'S ASSOCIATION TIMBER RESEARCH FELLOWSHIP

This fellowship, donated by the Canadian Lumbermen's Association, is offered to encourage advanced study and research in timber engineering. It is open to graduates in engineering and graduates in forestry of any recognized university. The fellow must be registered in the School of Graduate Studies as a student proceeding to a post-graduate degree and must carry out a prescribed programme of study and research in both engineering and forestry. It is intended that the work of this programme will extend over a period of two academic years. The annual value of the fellowship is $1,250, all of which might not be granted to one student.

Application should be made to the Secretary of the School of Graduate Studies not later than September 1st and should be accompanied by an official transcript of the applicant's undergraduate record, together with a statement of his experience in the forestry and construction fields.

CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA, LIMITED, RESEARCH FELLOWSHIP

The Consolidated Mining and Smelting Company of Canada, Limited, offers annually a Research Fellowship in the School of Graduate Studies

of $1,000 for a research in some field of pure or applied science; an additional amount of $500 is available for special equipment and supplies. The Fellowship is known as the "Cominco Research Fellowship."

It is open to graduates in Science, Engineering, or Agriculture of a recognized university and preferably a British subject resident in Canada.

Applications for the Fellowship must be made to the Secretary of the School of Graduate Studies, not later than September 1st.

COMMONWEALTH SCHOLARSHIPS

Under a Plan drawn up at a conference held in Oxford in 1959, each participating country of the Commonwealth offers a number of scholarships to students of other Commonwealth countries. These scholarships are mainly for graduate study and are tenable in the country making the offer. Awards are normally for two years and cover travelling, tuition fees, other university fees, and a living allowance.

For details of the awards offered by the various countries consult the Registrar's Office, or write to The Canadian Universities Foundation, 77 Metcalfe Street, Ottawa.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIPS

The Royal Commissioners for the Exhibition of 1851 have invited the University of Toronto to recommend annually one or more candidates in order of merit for science research scholarships, each of the value of £350 per annum and ordinarily tenable for two years. The Commissioners may make a supplementary grant up to £50 per annum for University fees, etc., payable by the scholar during his tenure of the award.

Each candidate recommended must be a British subject, and under twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University, the students of which are eligible to apply for these scholarships: 1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (me-

chanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geological Sciences; 13. Physics; 14. Physiology; 15. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the university, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board is appointed by the Senate and has power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than April 15th to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

IMPERIAL OIL GRADUATE RESEARCH FELLOWSHIPS

Imperial Oil Limited, in 1946, established for annual competition four Graduate Research Fellowships now having a potential value of $3,750.00 each ($1,250.00 a year payable in Canadian funds for a maximum of three years). The fellowships are open to graduates of any approved University in Canada and are offered for graduate study leading to a Master's or Doctor's degree in the fields of Chemistry and/or Engineering (two fellowships), Geology (one fellowship), and Economics or Industrial Relations (one fellowship). Nomination of students for the fellowships is made by the University—such nominations to be received by Imperial Oil Scholarship Committee, Imperial Oil Limited, 56 Church Street, Toronto, not later than June 1st of each year. Nomination forms and information as to the terms of the followships are obtainable at the Registrar's Office.

THE INTERNATIONAL NICKEL GRADUATE RESEARCH FELLOWSHIPS

The International Nickel Company of Canada has established a number of Graduate Research Fellowships, to promote and encourage research in the technical fields serving the Canadian metal industries and to further public interest in industrial science in Canada. Each has a possible tenure of three years with an annual payment of $2,500, of which $2,000 is payable to the fellow and $500 is placed at the disposal of the directing professor for necessary materials or equipment. It is expected that four new fellowships will be awarded in 1961.

Applications on behalf of competent graduate students will be considered from any Canadian university qualified to confer the Master's or Doctor's degree in Geology (including Geophysics), Mining, Ore Dressing, Metallurgy (both process and physical), Chemistry (pertaining to

metals), Physics (pertaining to metals), and Mathematics. Awards are made by a committee appointed by the National Conference of Canadian Universities and Colleges.

Application should be made to the International Nickel Company of Canada, Limited, 55 Yonge Street, Toronto 1, Ontario, not later than February 14.

THE JOHNSON FOUNDATION SCHOLARSHIP AWARD

The Johnson Foundation through S. C. Johnson and Son Limited, Brantford, Ontario, offers one scholarship each year for study in a United States College or University in undergraduate or postgraduate fields of study such as economics, business administration, chemistry, engineering, teaching, etc. The amount of the scholarship varies according to the requirements of each student.

Further information may be obtained from S. C. Johnson and Son Limited, Brantford, Ontario, and preliminary application must be received by them not later than December 31st.

MCCHARLES PRIZE

This prize, the gift of the late Æneas McCharles of the value of $1,000, is awarded from time to time but not necessarily every year on the following terms and conditions: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions determine the method of award.

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000) in money.

(3) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(4) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE UNIVERSITY OF MANCHESTER TORONTO FUND

The University of Manchester has accepted the gift of a sum of £1,699 from a Committee representing the parents of children who during the war were evacuated to Toronto and other places in Canada.

The capital and any income arising therefrom will be used to make grants to Canadians wishing to conduct post-graduate studies and/or research in the University of Manchester, preference being given to students who have graduated from the University of Toronto. The total amount of grant or grants to any student will not exceed £100. Applications must be submitted to the Registrar of the University of Toronto on or before January 1st of the year in which the applicant wishes to enter the University of Manchester, together with transcripts of undergraduate and graduate record and outlines of the post-graduate studies and/or research to be followed at the University of Manchester.

NATIONAL SEWER PIPE COMPANY LIMITED SCHOLARSHIP

The National Sewer Pipe Company Limited has established a scholarship of a value of Five Hundred Dollars ($500.00) in the School of Graduate Studies. It is awarded annually to a student who undertakes to enroll in that School, proceeding to the degree of Master of Applied Science in the graduate Department of Civil Engineering and in the course in Public Health Engineering.

Applications must be submitted to the Secretary of the School of Graduate Studies on or before March 1st.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering, to be known as The Nipissing Mining Company Research Fellowship, of the annual value of the income from the fund, plus free tuition.

This Fellowship is open to graduates of any University.

H. W. PRICE RESEARCH FELLOWSHIP IN ELECTRICAL ENGINEERING

The H. W. Price Research Fellowship in Electrical Engineering consisting of the income or a part thereof but not exceeding the income for three years derived from the sum of $10,000 donated by the Hydro Electric Power Commission of Ontario, will be awarded from time to time as recommended by the School of Engineering Research, to a graduate in Electrical Engineering of any recognized University, registered in the School of Graduate Studies, wishing to proceed with an investigation in the field of Electrical Engineering.

Forms of application may be obtained from the Secretary, School of Graduate Studies, and should be returned with a statement of qualifications not later than March 1st. The first award was available in 1943.

THE RAYMOND PRIESTLEY FELLOWSHIP

The University of Birmingham being "anxious to mark its indebtedness and its gratitude" for the hospitality shown during the Second World War to children of members of its teaching staff by members of the University of Toronto, has set aside a research fellowship to be

held by a graduate of the University of Toronto. This fellowship, to be known as the Raymond Priestley Fellowship, of the value of £450 per annum as well as the cost of the return passage from Canada, is available for graduates, both men and women, preferably those who have already shown some capacity for and interest in research. The fellowship will normally be awarded for a period of three years. It is tenable in any faculty of the University of Birmingham. The Fellow will undertake research and may, if he wishes, be a candidate for a higher degree at the University of Birmingham. The selection of the candidate will be made by the University of Toronto. The process of selection will include negotiation with the head of the department concerned in the University of Birmingham to ensure that there is in the University opportunity for the pursuit of the particular line of research required. Applications must be submitted to the University Registrar not later than March 1st, together with transcripts of undergraduate and graduate records and outlines of the research to be undertaken at the University of Birmingham.

THE ROYAL INSTITUTION OF GREAT BRITAIN SCIENCE RESEARCH SCHOLARSHIPS

A scholarship of the value of £350 per annum with a possible additional allowance of £50, to be held ordinarily for a period of two years, will be offered each year to a candidate from one of the universities of Canada, Australia, New Zealand and South Africa, and is tenable only in the Davy Faraday Research Laboratory of the Royal Institution, London. No candidates will be considered except those who have been recommended for the 1851 Exhibition Science Research scholarships, and candidates who wish to be considered also for the Royal Institution scholarships are requested to state this clearly in the application for an 1851 scholarship. No other application to the Royal Institution is necessary. Copies of the regulations relating to these scholarships may be obtained from the University Registrar.

STEEL COMPANY OF CANADA, LIMITED, FELLOWSHIP

The Steel Company of Canada, Limited, offers annually a Research Fellowship in the School of Graduate Studies for fundamental research on the physics and chemistry of metals in the Department of Metallurgical Engineering. The Fellowship is valued at $1,500.00 to the Fellow and $500.00 to the University for special equipment and supplies required in research. Applications should be submitted to the Secretary of the School of Graduate Studies not later than March 1st.

SPRUCE FALLS POWER AND PAPER COMPANY, LIMITED, FELLOWSHIP

The Spruce Falls Power and Paper Company Limited has established a Fellowship for the encouragement of research in the Faculty, of an annual value of $1200. It is open to graduates of the University of Toronto or of other recognized universities, but is restricted to Canadian

Citizens. Application should be sent to the Secretary of the School of Graduate Studies, not later than March 1st.

The Fellowship also carries a grant of $300 to be applied to the tuition of the holder and $300 to the general University Funds.

THE 1940 TORONTO FUND

The 1940 Toronto Fund, the gift of Oxford University, of the value of £3000, was set up in 1940 by the parents of Oxford children who were taken into Canadian and American homes during the War. Recommendations for grants from the income from the Fund will be made from time to time by the Senate of the University of Toronto to members of the University "who wish to go to Great Britain for the purpose of study, research, or any general educational purpose, taking education in the widest possible sense." Each applicant for a grant from this Fund must submit his application to the University Registrar not later than March 1st together with an outline of the study or research which he proposes to undertake in Great Britain, or the general educational purpose which he has in mind in going there.

WALLBERG RESEARCH FELLOWSHIPS

Three Wallberg Research Fellowships of the value of $2,000 each are open to graduates of any recognized university who propose to pursue advanced study and research in any branch of Engineering in the University of Toronto.

Forms of application may be obtained from the Secretary of the School of Graduate Studies. These should be returned together with a transcript of academic record and an outline of the proposed study and research not later than March 1st.

THE CHARLES G. WILLIAMS FELLOWSHIP IN URANIUM METALLURGY

Eldorado Mining and Refining Limited offers a postgraduate scholarship in Uranium Metallurgy to a graduate in the physical sciences, pure and applied of a value of $1,500 for an academic year and the holder is also eligible for a supplementary amount of $800 for the summer months. A cash grant to the University accompanies the fellowship.

Application forms may be obtained from the Registrar of the University and submitted to the Secretary, Eldorado Mining and Refining Limited, P.O. Box 379, Ottawa, Ontario, before 15th March.

GARNET W. MCKEE LOAN AND SCHOLARSHIP FUND

The late Mrs. Garnet W. McKee has given this fund to assist students of promise at the University of Toronto, and to develop and extend by research the following subjects studied in the Engineering Physics course in the Faculty of Applied Science and Engineering, especially in their application to the industries of Canada: Electricity and Communications; X-rays and Spectroscopy; Illumination and Acoustics; Geophysics; Refrigeration; Aeronautics.

In each session $800 from the annual income of the fund will be allotted to provide the Garnet W. McKee Scholarship, tenable preferably by a graduate who was eligible for a loan in a previous session, or who is in at least the second year of his graduate work.

Each holder of the said Scholarship and each graduate to whom a loan is granted will be required in the following session to enrol in the School of Graduate Studies and to pursue studies leading to a graduate degree in one or more of the subjects listed, and he may not engage in remunerative employment during the session except by permission of the Committee of Award.

Applications for a loan must be made to the Secretary of the School of Graduate Studies not later than September 1st.

Applications for a Scholarship must be accompanied by an outline of the proposed research problem.

LOAN FUNDS

From the loan funds mentioned below, small loans can be made to students who are in urgent need of assistance. The funds are not large and the loans must accordingly be restricted, both in amount and number, and principally to students in the Third and Fourth Years.

Enquiries for loans from any of the following funds should be made at the office of the Secretary of the Faculty.

- Engineering Alumni Loan Fund
- Engineering Society Loan Fund
- Elizabeth Speller Memorial Fund
- James W. Crocker Memorial Fund
- Harry F. Bennett Educational Fund
- S.A.E.—Canadian Section Loan Fund
- Class of 2T7 (SPS) Memorial Loan Fund
- Avro Aircraft Limited Engineering Loan Fund
- Association of Professional Engineers Loan Fund
- The William Storrie Memorial Fund
- 3T6 Engineers Loan Association
- 4T0 Engineering Loan Fund
- Women's Association of the Mining Industry in Canada Loan Fund
- The Devonshire Loan Fund

CLASS OF 1936 LOAN ASSOCIATION

Members of the Class of 1936 have made arrangements to assist students in obtaining loans through regular banking facilities. Information may be obtained from the Secretary of the Faculty.

ENGINEERING ALUMNI LOAN FUND

The Engineering Alumni Association established in 1950 a loan fund to assist engineering students, especially in the Third and Fourth Years.

Applications for loans from this fund should be made to the Secretary of the Faculty.

CLASS OF 2T7 (SPS) MEMORIAL LOAN FUND

This fund was established in 1955 to memorialize the Class of 1927 of the Faculty of Applied Science and Engineering.

Loans to a total of $250 are available to any undergraduate who has completed one Year, with or without conditions, and who has qualified for the Second, Third or Fourth Year.

Application shall be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary of the Faculty.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller, of the Class of 1893, the "Elizabeth Speller Memorial Fund" has been established to provide loans for worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

JAMES W. CROCKER MEMORIAL LOAN FUND

This fund was established by Mrs. William Crocker in memory of her son, James W. Crocker, a graduate in Mining Engineering in 1938, who was killed in an accident in a mine in the same year.

HARRY F. BENNETT EDUCATIONAL FUND

This fund was established by subscription from members of The Engineering Institute of Canada in memory of the late Harry F. Bennett, M.E.I.C., who for six years prior to his death in 1946 was chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, and who accomplished so much in this field by untiring efforts.

One purpose of the fund is to make loans to deserving students who need financial assistance to enable them to study engineering sciences at university level, and who have proved themselves by successfully completing their first year in engineering or the equivalent.

Loans will be made largely on the basis of character and to men who seem likely to develop the high professional standards which are essential to leadership in engineering science. A student who has been aided

by this fund should feel that high obligations are placed on him; obligations to the subscribers, to the trustees, and to those coming after him who in turn can receive help as his loan is repaid.

Application forms may be obtained at the Faculty Office. The regulations are simple and the application of any worth-while student will be given immediate and careful attention.

SOCIETY OF AUTOMOTIVE ENGINEERS—CANADIAN SECTION LOAN FUND

The Society of Automotive Engineers—Canadian Section has established a loan fund of $1,200.00 in the Faculty of Applied Science and Engineering. Preference is given to students in good scholastic standing and engaged in studies relative to the automotive and aircraft industries, and to students in fourth, third and second years in that order. Particulars may be obtained from the Secretary of the Faculty.

AVRO AIRCRAFT LIMITED ENGINEERING LOAN FUND

Avro Aircraft Limited has established a Loan Fund of $3,000.00 to provide loans to engineering students requiring financial assistance. Application should be made to the Secretary of the Faculty.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO LOAN FUND

The Association of Professional Engineers has made loans not exceeding $200 available to students in the First, Second and Third Years in this Faculty. Application should be made to the Association at 236 Avenue Road, Toronto.

THE WILLIAM STORRIE MEMORIAL FUND

The William Storrie Memorial Fund has been established by Mrs. William Storrie to provide loans to undergraduates in the course in Civil Engineering. Application should be made to the Secretary of the Faculty.

THE DEVONSHIRE LOAN FUND

This Fund has been established by Graduates and friends of Devonshire House to assist students in the Residence. Application should be made to the Office of the Dean of Devonshire House.

CLASS OF '09 TRUST FUND

The Class of '09 on the 50th Anniversary of their graduation made a sum of money available in the Faculty for financial aid to undergraduates, with preference to Second Year students. Inquiry should be made to the Secretary of the Faculty.

SECTION XI. DISCIPLINE

1. (*a*) The Council of every Faculty and School has disciplinary jurisdiction over the conduct of students connected with the writing of examinations and all other matters relating to courses of instruction conducted by or under the authority of the Council, and in all matters of what might be called local or internal concern. Jurisdiction over the conduct of students while in residence, regardless of the Faculty in which they are registered, is vested in a body representing the authority administering the residence.

(*b*) Disciplinary jurisdiction in all other respects is vested in the Caput.

2. Students are required to attend the courses of instruction and the examinations in all subjects prescribed for students of their respective standing. A student whose attendance at lectures or laboratories, or whose work, is deemed by the Council of the Faculty in which he is registered, to be unsatisfactory, may have his registration cancelled at any time by the Council of the Faculty.

3. All interference on the part of any student with the personal liberty of another by arresting him, or summoning him to appear before any tribunal of students, or otherwise subjecting him to any indignity or personal violence, is forbidden by the Caput and by the Councils of the colleges and faculties.

4. No initiation ceremony involving personal violence, personal indignity, interference with personal liberty, or destruction of property, may be held by the students of any college or faculty of the University, under the penalty of suspension of expulsion.

5. Any reception of the students of the first year in any college or faculty must be approved by the Council of that college or faculty, but such reception must not involve any infraction of the regulations of the two preceding paragraphs.

6. The organizing of a parade in the streets of the city, or the taking part in such parade without the permission of the authorities of the city on application of the Students' Administrative Council, will be regarded as a breach of discipline.

7. The use of loud-speaking equipment in University buildings or grounds, whether stationary or moving, or whether operated by students or others, is forbidden except by permission of the Board of Governors or the Caput.

8. Any individual or individuals directly responsible for an undesirable feature in connection with any Stunt Night or other entertainment given under the auspices of a student organization will be subject to disciplinary action by the Caput.

9. A committee of staff and students appointed by the Council of the college, faculty or school concerned will provide effective supervision of the programmes of all Stunt Nights and other public entertainments and will see that the programme follows the script as approved by the Council concerned.

10. The holding of beauty contests or similar exhibitions by university students, whether under the name of the University or under the auspices of organizations recognized by the Caput, is forbidden.

11. The constitution of every university society or association of students in any college, faculty or school, and all amendments to any such constitution must be submitted to the Caput. Responsibility for the conduct and programmes of each society or association of students drawing its membership from a single college, faculty or school shall rest with the Council of the college, faculty or school concerned. Responsibility for the programmes arranged by the committees of Hart House and controlled by the Board of Stewards of Hart House shall rest with the Board of Stewards. Responsibility for the conduct and programmes of every other society or association of students shall rest with the Caput.

12. The name of the University is not to be used in connection with a publication of any kind without the permission of the Caput.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1959–60

Year	1	2	3	4	5	6	7	8	9	Total
I	72	6	76	23	116	77	91	15	17	493
II	67	14	61	45	125	65	73	9	11	470
III	74	14	82	31	75	53	80	16	12	437
IV	106	20	82	36	73	45	97	12	25	496
Total	319	54	301	135	389	240	341	52	65	1896
Special Students										7
										1903

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UNIVERSITY OF TORONTO

CALENDAR

Faculty of Applied Science and Engineering

1961-1962

UNIVERSITY OF TORONTO PRESS
1961

CALENDAR 1961

Jan.

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CALENDAR 1962

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SECTION 1. CALENDAR 1961–62

FALL TERM, 1961

July 1	*Saturday*	Dominion Day. Buildings closed.
July 10	*Monday*	Last day for receiving applications for supplemental examinations.
August 7	*Monday*	Civic Holiday. Buildings closed.
August 8	*Tuesday*	Supplemental Examinations commence.
August 14	*Monday*	Students of the III Year, Course 1, report at Survey Camp.
August 21	*Monday*	Students of the III Year, Course 2 and 9, report at Survey Camp.
September 1	*Friday*	Last day for receiving applications for admission to the I Year.
September 4	*Monday*	Labour Day. Buildings closed.
September 5	*Tuesday*	Students in IV Year, Course 1, Group B, report at Survey Camp.
September 6	*Wednesday*	Students in II Year, Course 6, report for Analytical Chemistry Laboratory.
September 7	*Thursday*	Special Meeting of Faculty Council.
September 14 September 15	*Thursday* *Friday*	Registration in person of the I Year from 9.30 a.m. to 12 noon and from 2.00 p.m. to 4.30 p.m. at 119 St. George Street.
September 18	*Monday*	Registration in person of the II and III Years from 9.30 a.m. to 12 noon, and from 2.00 p.m. to 4.30 p.m. in the Galbraith Building.
		Dean's address to the I Year.
		Preliminary instruction to the I Year.
September 19	*Tuesday*	Registration in person of the IV Year from 9.30 a.m. to 12 noon, and 2.00 p.m. to 4.30 p.m. in the Galbraith Building.
		Meeting of Faculty Council.
September 20	*Wednesday*	Lectures and Laboratory work commence at 9.00 a.m.
		Opening address by the President to the students of all Faculties at 3.45 p.m. in Convocation Hall.
October 5	*Thursday*	Meeting of Faculty Council.
October 9	*Monday*	Thanksgiving Day. Buildings closed.
October 13	*Friday*	Meeting of Senate.

November 1	*Wednesday*	Meeting of Faculty Council.
November 10	*Friday*	Meeting of Senate.
November 11	*Saturday*	Remembrance Day Service 10.45 a.m. Lectures and Laboratory classes withdrawn from 10.00 a.m. to 12 noon.
November 24	*Friday*	Fall Convocation.
December 1	*Friday*	Meeting of Faculty Council.
December 8	*Friday*	Meeting of Senate.
December 19	*Tuesday*	First Year Term Examinations.
December 20	*Wednesday*	First Year Term Examinations. Term ends at 5.00 p.m.
December 25	*Monday*	Christmas Day.

SPRING TERM, 1962

January 1	*Monday*	New Year's Day.
January 3	*Wednesday*	Spring term begins. Mid-session Examinations commence.
January 9	*Tuesday*	Meeting of Faculty Council.
January 12	*Friday*	Meeting of Senate.
January 15	*Monday*	Last day for receiving the second term instalment of fees.
January 18	*Thursday*	IV Year Employment interviews.
January 19	*Friday*	IV Year Employment interviews.
January 20	*Saturday*	IV Year Employment interviews.
February 2	*Friday*	Meeting of Faculty Council.
February 9	*Friday*	Meeting of Senate.
March 1	*Thursday*	Meeting of Faculty Council.
March 9	*Friday*	Meeting of Senate.
April 2	*Monday*	Meeting of Faculty Council.
April 5	*Thursday*	Term ends at 5.00 p.m.
April 13	*Friday*	Annual Examinations commence. Meeting of Senate.
April 20	*Friday*	Good Friday. Buildings closed.
April 21	*Saturday*	Buildings closed.
May 2	*Wednesday*	Meeting of Faculty Council.
May 11	*Friday*	Meeting of Senate.
May 21	*Monday*	Victoria Day. Buildings closed.
May 28	*Monday*	University Commencement.
May 29	*Tuesday*	University Commencement.
May 30	*Wednesday*	University Commencement.
May 31	*Thursday*	University Commencement.
June 1	*Friday*	University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

THE UNIVERSITY

President . . . . . C. T. Bissell, M.A., PH.D., D.LITT., LL.D., F.R.S.C.

Executive Assistant to the President . . . . . . J. H. Sword, M.A.
Director of University Extension . . . D. C. Williams, M.A., PH.D.
Chief Librarian . . . . R. H. Blackburn, M.A., B.L.S., M.S.
Registrar . . . . R. Ross, M.B.E., M.A.

Vice-President (Administration) . . . . F. R. Stone, B.COM., F.C.A.
Comptroller . . . . G. L. Court, D.F.C., M.COM. C.A.
Secretary of the Board of Governors . . . . J. F. Brook
Superintendent of Buildings and Grounds . . F. J. Hastie, B.SC., P.ENG.
Chief Accountant . . . . D. J. Reid

Director of Alumni Affairs . . . . J. C. Evans, B.A.
Director of Information . . . . K. S. Edey
Director of Development . . . . R. J. Albrant
Director of Graduate Register . . . . C. G. M. Grier, E.D., M.A.

Warden of Hart House . . . . J. McCulley, M.A.
Director of University Health Service
G. E. Wodehouse, M.C., M.D., F.R.C.P.
Assistant Director of University Health Service—Women
Miss F. H. Stewart, B.A., M.D.
Director of the Placement Service . . J. K. Bradford, O.B.E., M.A.SC.
Director of Athletics and Physical Education—Men W. A. Stevens, B.S.
Director of Athletics and Physical Education—Women
Miss Z. Slack, B.A.
General Secretary-Treasurer of the Students' Administrative Council
E. A. Macdonald, B.A.
Director of Hart House Theatre . . . . R. S. Gill, M.A.

Director of the University of Toronto Press . . . M. Jeanneret, B.A.

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean . . . . R. R. McLaughlin, M.A.SC., M.A., PH.D.
Assistant Dean and Secretary . . . . W. S. Wilson, E.D., B.A.SC.
Assistant Secretary . . . . J. A. Gow, B.A.SC.

SECTION III. TEACHING STAFF

1960–61

DEAN EMERITUS

C. R. Young, B.A.SC., C.E., LL.D., D.ENG., D.ès.SC.A., HON. M.E.I.C., M.AM.SOC.CE. — 172 Roxborough Dr.
Dean Emeritus, Faculty of Applied Science and Engineering

PROFESSORES EMERITI

E. A. Allcut, M.SC. (BIRM.), M.E., F.R.AE.S., — 315 Lawrence Ave. W.
Professor Emeritus of Mechanical Engineering

J. W. Bain, B.A.SC., LL.D., F.R.S.C. — 30 Burton Rd.
Professor Emeritus of Chemical Engineering

J. R. Cockburn, M.C., V.D., B.A.SC. — 100 Walmer Rd.
Professor Emeritus of Engineering Drawing

H. E. T. Haultain, C.E. — Mill Building
Professor Emeritus of Mining Engineering

T. R. Loudon, V.D., B.A.SC., C.E., HON. F.C.A.I. — 189 Sheldrake Blvd.
Professor Emeritus of Civil and Aeronautical Engineering

W. J. T. Wright, M.B.E., B.A.SC., B.A. — 126 Melrose Ave.
Professor Emeritus of Engineering Drawing

DEPARTMENT OF APPLIED PHYSICS

Professor and Head of the Department
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W. H. Gross, B.SC.(B.C.), M.A., PH.D. (Geol. Sciences) 25 Whitney Ave.
H. P. Gush, B.E., B.A., M.SC.(SASK.), PH.D. (Physics) 214 St. George St.
W. Kahan, PH.D. (Computation Centre) 290 St. Clair Ave. W.
D. Naylor, B.SC., PH.D. (Mathematics) 105–25th St., Long Branch
P. A. Peach, B.SC.(EDIN.), M.A., PH.D. (Geol. Sciences) 21 Touraine Ave.
J. D. Prentice, M.SC.(MCG.) (Physics) 150 Macpherson Ave.
M. G. Rochester, M.A., PH.D.(UTAH) (Physics) 271 Winnett Ave.
C. Steel, B.SC., PH.D.(EDIN.) (Chemistry) 27 High Park Blvd.
N. R. Steenberg, M.C., M.SC.(QU.), D.PHIL(OXON) (Physics)
32 Broadleaf Rd., Don Mills
R. Wormleighton, B.A., PH.D.(PRINC.) (Mathematics)
224 St. George St.

SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant-Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers, and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate, by statute subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909–1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910–1911. In the session 1923–24 the degree was changed to B. Arch. for the students graduating in Architecture. On July 1, 1948, the School of Architecture was separated from the Faculty and became an independent School with its own Director and Council.

With the end of the Second World War during the summer of 1945 the University was faced with the difficult problem of providing accom-

modation for almost double the number of students that had been registered in the previous year. Through the efforts of the Chairman of the Board of Governors and the President, the University leased from the Crown part of the large shell-filling plant at Ajax, twenty-five miles east of Toronto, to relieve the heavy demand for space at Queen's Park. Because it became evident, at an early stage, that a relatively large number of students would register in the Faculty of Applied Science and Engineering, it was decided that the work of the First and Second Years of this Faculty should be given at Ajax.

A special First Year session with approximately 1400 students commenced at Ajax on January 14, 1946. In the regular 1946–47 session both First and Second Year instruction, except Second Year in Architecture, was given at Ajax with 1800 registered in the First Year and 1500 in the Second Year. In the 1947–48 session the enrolment at Ajax consisted of 1200 students in the First Year and 1400 in the Second Year. In the session 1948–49, 600 were registered at Ajax in the First Year and 975 in the Second Year. All other instruction was given in Toronto.

To provide for this self-contained University community at Ajax, there were 446 acres and 111 buildings. The University operated such services as central heating, road maintenance, water supply, sewage disposal, fire department, transportation, post office, laundry, private hospital, cafeteria, tuck shop and barber shop. Former production-line buildings were altered to accommodate 37 lecture rooms, 20 draughting rooms and 14 laboratories. In the 1946–47 session, 2300 students were in residence, in 1947–48 there were 1800 students and in 1948–49 there were 900. Student life at Ajax compared favourably with that in Toronto, excellent accommodation being provided for a general circulating library, a technical library, Hart House Ajax, the Athletic Association, the Health Service, Students' Administrative Council, Advisory Bureau for Ex-Service Students, and a small chapel.

With the completion of the Wallberg Building and the extension of the Mechanical Building, additional accommodation became available on the Queen's Park Campus, and this fact coupled with the decrease in numbers entering each year brought about the closing of Ajax on May 31, 1949.

SECTION V. GENERAL INFORMATION, ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

RESTRICTION OF REGISTRATION

The right is reserved to limit the number of students admitted to any course in the Faculty.

1. GENERAL ADMISSION REQUIREMENTS

A candidate for admission to the first year must present the Ontario Grade 13 certificate or an equivalent certificate showing standing in the following subjects, with an overall average of at least 64%.

English:	Literature	
	Composition	
Mathematics:	Algebra	
	Geometry	
	Trigonometry	
Science:	Chemistry	
	Physics	
One of:	French	*Authors and Composition*
	German	
	Greek	
	Italian	
	Latin	
	Spanish	
	Russian	

A careful selection of the five subjects (nine papers) to be studied in the Grade 13 programme will allow the candidate to meet *both* the general and specific requirements.

Preferential consideration will be given to candidates who have completed the University admission requirements at the end of one year in Grade XIII in Ontario schools or in the equivalent year in other school systems. Applications will also be considered in the light of the Principal's Report, the previous school record of the applicant and other tests of the student's ability that are available.

SPECIFIC ADMISSION REQUIREMENTS

Applications for admission to the course in Engineering Physics, in addition to meeting the general requirements, must have an average of at least 70% in the nine papers. Those intending to pursue work in Aeronautical/Astronautical Engineering will register in Engineering Physics, in which course an option is offered in the Third and Fourth Years. For further information see page 62.

2. EQUIVALENT CERTIFICATES

The following certificates are usually accepted as equivalent to Ontario Grade 13. Standing in the following certificates is required as outlined in (1) above.

Canada:

Alberta, Manitoba, Nova Scotia, Saskatchewan—Grade 12.
British Columbia, New Brunswick—Senior Matriculation.
Newfoundland—First Year Memorial University.
Prince Edward Island—Third Year Certificate of Prince of Wales College.
Quebec—Senior High School Leaving Certificate or McGill Senior School Certificate.

United Kingdom

Passes in the General Certificate of Education, Advanced level in a mathematical subject and in either Physics or Chemistry; passes at the Ordinary level in English Language, English Literature, a language other than English, and in either Physics or Chemistry, whichever is not submitted at Advanced level.

United States of America:

A United States High School Graduation Diploma will not admit an applicant to this Faculty.

First Year College credits in the required subjects from accredited institutions will be accepted for admission, provided satisfactory standing is obtained and the approximate number of semester hours of credit obtained as indicated:

English (including an intensive course in Literature)	6
Algebra	3
Analytical Geometry	3
Plane Trigonometry	3
Physics	3
Chemistry	3
A language other than English	6

Applicants seeking admission on the basis of certificates not included in the above are advised to submit photostatic copies of their certificates to the Registrar of the University for evaluation. When these certificates are in a language other than English, notarized English translations must accompany the photostatic copies.

3. ADMISSION REGULATIONS CONCERNING CANDIDATES HAVING PREVIOUSLY FAILED

(a) A candidate who for the first time has failed a year at the University of Toronto or who has failed once at another institution of higher learning may be admitted to the University of Toronto subject to debarment.

(b) Students who on two occasions have failed to secure the right to advance to a higher year in university work will not be admitted to any undergraduate degree course in the University.

4. ADMISSION REGULATIONS—MATURE STUDENTS

With effect from 1st July 1961, a candidate of mature age (30 years or older on October 1st of the Session to which admission is sought) who is normally resident in Ontario, may request special consideration if he or she has not completed in full the published Grade 13 (or equivalent) requirements. Such an applicant must submit a birth certificate at the time of application.

5. ADMISSION REGULATIONS—PROBATIONARY STUDENTS: CONDITIONED STUDENTS

Students who have not presented in full the published admission requirements are normally admitted to the University on probation by special action of the Committee on Admissions. These students will fall into the category of either (a) those admitted on condition, or (b) those to whom special consideration is granted on the basis of maturity.

The following regulations apply to such students:

(a) Probationary students on condition are required to secure certain standing at the Ontario Grade 13 or equivalent level or in appropriate 1st Year University subjects. On obtaining such standing their probationary status and their condition are removed. If the admission condition is not satisfied within the period of time specified, such students will not be permitted to continue in the University or to enrol in any other course in the University until they present in full the published admission requirements.

(b) Students admitted as mature students on probation must obtain standing in their 1st Year of full time study in order to have their probationary status removed. If they do not obtain standing they will not be allowed to repeat the year or to enrol in any other course in the University of Toronto until they present in full the published admission requirements.

6. ENGLISH FACILITY REQUIREMENTS

All applicants are required to submit evidence acceptable to the University of Toronto of facility in English. Standing as outlined in one of the following will be regarded as acceptable evidence of English facility:

(a) Standing, in accordance with the General Admission Requirements, in English in the Ontario Grade 13 Certificate, or other certificates recognised by the University of Toronto as equivalent.

(b) The Certificate of Proficiency in English issued by the Universities of Cambridge or Michigan, or satisfactory achievement in the University of Michigan English Language Test. (Details regarding

the foregoing may be secured from the registrar, University of Toronto.)

The University is prepared to consider other evidence of English facility which should be submitted for evaluation to the Registrar of the University.

7. APPLICATION PROCEDURES

Candidates for admission should apply to the Registrar of the University for admission application forms. They are required to complete such forms and return them to the Registrar at the earliest date possible, *preferably by May 1st. Applications and certificates which have been obtained in Ontario educational institutions must be received by September 1st. Applications received after September 1st will be refused.* Other certificates and applications must be received by July 1st. Applications received after July 1st may be refused.

Application for Admission to First Year

(a) Candidates seeking admission to First Year must submit to the Registrar of the University:

(i) Completed application forms as outlined above.
(ii) Ontario Grade 13 or equivalent certificates indicating the subjects studied and the grades secured.
(iii) Such other information as may be required by the University.

(b) If a student has previously attended a University, the following must be submitted:

(i) Official transcripts issued by the University or College previously attended, giving the courses completed, with the standing and grades in each. Transcripts *must* indicate that the candidate has been granted honourable dismissal and may return to the institution concerned in the session to which he seeks admission in the University of Toronto.
(ii) Official statement(s) or calendar(s) giving full information of the content of the University courses covered by the transcripts submitted.

(c) *Application for Admission with Advanced Standing*

Applicants seeking admission on an Advanced Standing basis must submit to the Registrar, prior to the dates mentioned above in the Session in which they wish to enrol:

(i) Completed application forms as outlined above.
(ii) Certificates giving detailed information as to subject and grades secured in the successful completion of Ontario Grade 13 or equivalent examinations.
(iii) Official transcript(s) issued by the Universities previously attended, giving in detail the courses completed with the standing or grade in each. Transcripts must indicate that the applicant concerned has been granted honourable dismissal, may return to the institution concerned, whether the last year at the

institution was successfully completed and whether the next higher year may be entered.

(iv) Official statement(s) or calendar(s) giving full information on the content of the university courses covered by the transcript(s) submitted.

8. HEALTH REQUIREMENTS AND REGISTRATION PROCEDURES

(a) Every person admitted to the University as an undergraduate must, at the time of his or her first medical examination by the University Health Service, present satisfactory evidence of successful vaccination, or must be vaccinated by the examining physician.

(b) A student who fails to register at the prescribed time will be required to pay an additional fee of $10.00 for late registration to the Chief Accountant. The Council of the Division to which an applicant has been admitted may at its discretion refuse a student permission to register late.

(c) A student must comply with such other registration procedures as may be required by the University.

9. PROCEDURE FOR TRANSFERS AND WITHDRAWALS

A student desiring to transfer to another division of the University or to withdraw from the University, must surrender his Admit-to-Lectures Card to the appropriate officer of the division concerned and must complete withdrawal forms as required by the University. In order that adjustment of fees may be made, notice of transfer or withdrawal must be completed without delay. In the case of a student who wishes to transfer to another division at the time of first admission to the University, it is required that such a student apply for an amended admission letter to the Registrar of the University.

10. DEBARMENT REGULATIONS OF THE UNIVERSITY*

Subject to other statutes and regulations of the University,

(a) any student who on two occasions fails to secure the right to advance to a higher year in University work shall be debarred from registration in the University.

(b) any student who withdraws after the 15th February, or who does not withdraw but does not write the annual examinations, shall be regarded for the purposes of debarment from the University as having failed his year.

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*These regulations apply to students enrolled in all Divisions of the University *except* the Faculty of Law, the Professional years in the Faculty of Medicine, the School of Social Work, the School of Graduate Studies and all other Post Graduate Divisions of the University.

SPECIAL STUDENTS

Graduates of the University of Toronto and of recognized universities who wish to take one or more undergraduate subjects may be registered as special students in the Faculty of Applied Science and Engineering, subject to the approval of the teaching department concerned. Application must be made to the Secretary of the Faculty.

RESIDENCE ACCOMMODATION

There is a University Men's Residence (Devonshire House) for which men undergraduates are eligible but which can accommodate only a small percentage of them. Early application is advisable. Apply to the Secretary, Men's Residences, Simcoe Hall.

Each of the four Arts Colleges also maintains a Men's Residence into which some engineering students are accepted. Further information may be obtained from:

University College—Dean of Men
Victoria College—Senior Tutor
Trinity College—Registrar, Trinity College
St. Michael's College—The Superior

HOUSING SERVICE

For those students who are not accommodated in the University and College residences, the Students' Administrative Council prepares annually a list of rooming houses, flats, apartments and homes. This list may be consulted at the housing office in The Students' Administrative Council building after 1st August and throughout the session.

To meet the housing shortage in Toronto, the Students' Administrative Council has greatly expanded its Housing Service. Every effort is being made to provide family accommodation for married students. Information may be obtained from the Students' Administrative Council's Housing Service office, the Observatory.

Through this service many opportunities have been afforded students, including students who are married, to obtain lodgings and board in exchange for part-time service. Students desiring this type of accommodation are asked to indicate this when they apply.

CHILDREN OF WAR DEAD (EDUCATION ASSISTANCE) ACT

Children of War Dead (Education Assistance) Act provides fees and monthly allowances for children of veterans whose death was attributable to military service. Enquiries should be directed to the nearest District Office of the Department of Veterans Affairs.

SECTION VI. FEES, DEPOSITS AND EXPENSES

FEES

1. A student who desires to enrol in the Faculty of Applied Science and Engineering is required to pay at least the First Term Instalment of fees on or before the opening date of the session, and before he can receive his registration card from the Secretary of the Faculty. The amount of the First Term Instalment of fees or of the Total Fee for the session may be ascertained from the schedule of fees below.

2. The Second Term Instalment of fees, if not already paid, is payable on or before January 15th. After this date an additional fee of $3.00 per month or portion thereof (not exceeding $10.00), will be imposed until the whole amount is paid. All fees for the session must have been paid in full before the student can be admitted to the annual examinations.

3. In order to avoid delay in registration at the opening of the session it is recommended that at least the First Term Instalment of fees be forwarded by mail as early as possible in September, together with a form, in duplicate, to be provided by the Secretary of the Faculty and filled out by the student, giving his full name, course, year, etc.

4. University fees are payable at the Office of the Chief Accountant, Simcoe Hall, which will be open for the receipt of fees from 9 a.m. to 5 p.m. daily from September 5th to 19th (Saturday, September 16th, 9 a.m. to 12 noon), and from 9 a.m. to 1 p.m. daily except Saturday during the remainder of the session. Cheques in payment of these fees should be made payable to the University of Toronto at par in Toronto.

5. Each undergraduate enrolled in the Faculty of Applied Science and Engineering must pay annual fees to the Chief Accountant according to the schedule below; the total fee in each case is made up of the academic fee and incidental fees; all incidental fees are payable in the first term.

Schedule of Fees

Academic Year	*Academic Fee	†Incidental Fees	Total Fee (if paid in one instalment)	First Term Instalment	Second Term Instalment
Men					
I-IV	$600	$57	$657	$357	$303
Women					
I-IV	$600	$31	$631	$331	$303

*The Academic Fee includes the following fees:—
Tuition; Library and Laboratory Supply; one Annual Examination; Laboratory Fee; Physical Education; and Degree.

†These Incidental Fees include the following fees:—
For men—Hart House; Students' Administrative Council; Athletic; Health Service; Engineering Society; Faculty Athletic Association.
For women—Students' Administrative Council; Athletic; Health Service; Engineering Society.

6. A late registration fee of $10.00 will be assessed against any student who registers after the last date for normal registration in his or her faculty or school.

OTHER UNIVERSITY FEES

7. Each student is required to pay to the Chief Accountant at the opening of the session, or as otherwise specified, such of the following fees as may be required of him.

EQUIVALENT CERTIFICATE FEE

8. Each student who has been admitted to the First Year upon a certificate or certificates granted outside the Province of Ontario and covering all or any part of the admission requirements, must pay a fee of $5.00.

ADVANCED STANDING FEE

9. Each student who has been admitted to advanced standing from another university or college, must pay a fee of $10.00.

SPECIAL PHYSICAL EDUCATION FEE

10. Each student who has neglected to complete satisfactorily the course in Physical Education of the First Year, and who must take this work during the Second Year of his or her attendance must pay a fee of $50.00.

SUPPLEMENTAL EXAMINATION FEES

11. Each candidate for a supplemental examination is required to pay a fee to the Chief Accountant not later than August 9th. The fee is $10.00 for one subject and $5 for each additional subject, including laboratory supplementals. For each supplemental examination in a laboratory subject requiring special supervision, there is an additional fee of $10.00. The additional laboratory supplemental fee should not be paid until the candidate is notified by the Secretary.

SPECIAL STUDENTS FEES

12. The fee is $85.00 per subject, payable to the Chief Accountant.

SUMMARY OF STUDENTS' EXPENSES

13. The following approximate statement of expenses will give the student a general idea of the cost of obtaining an education in the Faculty of Applied Science and Engineering in the University of Toronto, exclusive of personal expenses:—

1. Fees, see schedule, page 26.
2. Board and Lodging, per week ....$20.00 up
3. Books and instruments, per year ....about $100

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating course in which he intends to proceed to a degree. There are nine courses in Engineering, from which the selection may be made, viz.,

Civil Engineering (Course 1),
Mining Engineering (Course 2),
Mechanical Engineering (Course 3),
Industrial Engineering (Course 4),
Engineering Physics (Course 5),
Chemical Engineering and Applied Chemistry (Course 6),
Electrical Engineering (Course 7),
Metallurgical Engineering (Course 8),
Applied Geology (Course 9),
Aeronautical/Astronautical Engineering (see page 61).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the above courses.

3. The courses extend over four academic years. A student must pass in the work of each academic year before proceeding to the work of the next. See Sec. IX.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 15.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction are given in Sec. VIII.

7. Examinations are conducted as explained in Sec. IX.

8. Students in Civil Engineering, Mining Engineering, Mechanical Engineering, Industrial Engineering, Chemical Engineering, Electrical Engineering, Metallurgical Engineering and Applied Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. (See Sec. VIII.)

GRADUATE STUDY AND RESEARCH

Facilities are available in the Departments of the Faculty, for graduates with good records of this University or of another University of comparable standing, for post-graduate study and research leading to

the degrees of Master of Applied Science (M.A.Sc.) and Doctor of Philosophy (Ph.D.). For further information see the Calendar of the School of Graduate Studies. In some cases financial support for equipment and salaries of research assistants may be obtained through the School of Engineering Research, an organization within the Faculty established by the late Dean Ellis in 1917, or from other sources.

Bursaries and Scholarships for graduate students are available in limited number as shown on page 131. Many part-time demonstratorships are open which permit post-graduate work towards a degree.

INTERIM HIGH SCHOOL ASSISTANT'S CERTIFICATE, TYPE A

Graduation in Engineering Physics is accepted by the Ontario College of Education as meeting the academic requirements for admission to the course leading to a Type A certificate in Mathematics and Physics.

ASSOCIATIONS OF PROFESSIONAL ENGINEERS

Graduation from the Faculty of Applied Science and Engineering leads to registration as a Professional Engineer in the various Associations of Professional Engineers throughout Canada.

SECTION VIII. CURRICULUM

The courses of instruction are designed to give the student a thorough grounding in the fundamentals of engineering, and, in addition, sufficient familiarity with the practical application of the principles to make him useful upon graduation. The courses are very similar in the First Year with the exception of Engineering Physics. In the succeeding years specialization develops to some extent with provision in the Third and Fourth years for optional subjects in some of the graduating courses.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As the future engineer is vitally concerned with the development of the country, it is essential that he be instructed in the rudiments of economics, administration, and business, which, with his scientific training, will enable him to increase his usefulness to the full.

Recognizing the growing emphasis of outstanding engineers and of the great professional organizations on the importance of breadth in engineering education, this Faculty liberalized its curricula, effective with the session 1944–45. The subjects that are considered to belong to the liberal system, involving about 6 per cent of the total time of four undergraduate years, are the following: English, Economics, Modern World History, Political Science and Philosophy of Science.

Care has been taken to co-ordinate the liberal studies of the curriculum in such a manner as to form an integrated whole. Each derives support from those that have gone before and is the better understood by reason of them.

While a knowledge of these subjects does not form a part of the technical equipment of the engineer, it does add markedly to his ability to function as a broadly educated and effective citizen and thereby advances the prestige of his profession and himself in the mind of the general public.

The student who thoughtfully attends to what is offered in this so-called humanistic-social programme and follows it by self-directed reading and reflection will without question add notably to his qualifications for ultimate professional leadership. He will be the better able to discharge the double obligation laid upon him—to perform his technical duties efficiently and honourably and equally to contribute to the political, social, and cultural welfare of the community and country in which he lives.

In some graduating courses, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances, the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful

training in methods of research. In this way the undergraduate course is linked with the graduate courses and with the work of the School of Engineering Research (page 29).

As part of the laboratory instruction, excursions to places of technical interest, both in Toronto and elsewhere, are arranged by the staff. These excursions are treated as laboratory periods with the same requirements as to attendance and reports.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The programme and regulations regarding the courses of study and examination, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course to the conditions here laid down.

Communications relating to curricula, instruction, and examinations in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information regarding the courses of study leading to the post-graduate degrees, Master of Applied Science, and Doctor of Philosophy, see the calendar of the School of Graduate Studies, which gives full particulars.

FIRST YEAR CURRICULUM

The courses in Mechanical Engineering. Industrial Engineering, Chemical Engineering, Electrical Engineering and Metallurgical Engineering, designated as Division A have a common First Year and the courses in Civil Engineering, Mining Engineering and Applied Geology have a common First Year differing from that of Division A only in that Surveying is included. The First Year curriculum in Engineering Physics is designated as Division C.

A student, on petition to the Council, may be permitted to change his course at the end of the First Year.

FIRST YEAR CURRICULUM

Division A		Division B
Mechanical Engineering		Civil Engineering
Industrial Engineering	AND	Mining Engineering
Chemical Engineering		Applied Geology
Electrical Engineering		
Metallurgical Engineering		

First Year Subjects Divisions A & B	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	221, 222	2	3	2	3
Engineering Problems and Drawing	275	–	6	–	6
English	610	1	–	1	–
Political Science	323	1	–	1	–
Mathematics:					
Analytical Geometry	492, 275	1		1	
Calculus	490, 275	2	3	2	3
Descriptive Geometry	269	1		1	
Physics:					
Electricity	330	2		2	
Mechanics	20	2	3	2	3
Structure and Properties of Matter	676, 677	2		2	
Physical Education	640	–	2	–	2
Practical Experience	690	–	–	–	–
Surveying (Division B only)	710, 712	1	3	–	–

Division C
Engineering Physics

First Year Subjects Division C	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	223, 222	2	3	2	3
Engineering Problems and Drawing	276	–	6	–	6
English	610	1	–	1	–
Political Science	323	1	–	1	–
Mathematics:					
Algebra and Geometry	502, 276	2	–	2	–
Calculus	503, 276	2	–	2	–
Descriptive Geometry	269	1	–	1	–
Physics:					
Electricity	331	2	–	2	–
Statics	21	2	–	–	–
Properties of Matter; Mechanics and Heat	650, 651	3	4	3	4
Physical Education	640	–	2	–	2

CIVIL ENGINEERING

(Course 1)

The normal course in Civil Engineering has been so designed as to be broad and comprehensive, with a view to meeting not only the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire a technical training of such a basic character as to enable them to enter various other fields of technical employment. Concurrent with the instruction in engineering subjects, sufficient attention is given to economic, legal, and administrative matters to make the graduate in this course fitted to enter not only upon such work as Municipal Engineering, Sanitary Engineering, Highway Engineering, Railway Engineering, Geodetic Surveying, Structural Engineering, and Hydraulic Engineering, but also upon administrative and executive work in both engineering and industrial undertakings.

The subjects of instruction are shown in the following tables. In these tables reference numbers have ben assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Physics	70, 71	2	3	–	–
Calculus	491	2	–	2	–
Descriptive Geometry	272	2	–	–	–
Dynamics	22	1	–	1	–
Economics	311	2	–	2	–
Electric Circuits and Machines	347, 348	1	–	2	1½
Engineering Chemistry	226	2	–	–	–
Engineering Problems and Drawing	284	–	10½	–	6
Least Squares	494	–	–	–	3
Mechanics of Materials	23, 31	2	–	2	3
Physical Metallurgy	538	–	–	2	–
Practical Astronomy	200	1	–	1	–
Practical Experience	690	–	–	–	–
Surveying	714, 716	2	3	1	3

Third Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Elasticity	33, 34	1	$1\frac{1}{2}$	1	$1\frac{1}{2}$
Cements and Concrete	35, 44	2	3	1	–
Control Surveys	201	–	–	1	–
Differential Equations	507, 516	1	$1\frac{1}{2}$	1	$1\frac{1}{2}$
Engineering Geology	382, 383	2	2	2	2
Engineering Thermodynamics	434	2	–	1	–
Fluid Mechanics	440, 441	2	–	2	3
Modern World History	324	2	–	2	–
Municipal Planning, Administration and Transportation	216	2	–	1	–
Photogrammetry	75	–	3	–	–
Practical Experience	690	–	–	–	–
Structural Engineering	28, 51	2	6	2	6
Survey Camp	720	–	–	–	–

Students in Civil Engineering are required to state not later than June 30th following the completion of their Third Year the options they desire to pursue in the Fourth Year. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Fourth Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Construction Management and Business	218	–	–	2	–
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Highway Engineering	217	1	–	1	–
Hydraulic Engineering	445, 446	2	1½	2	3
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Reinforced Concrete	41, 42	2	1½	1	1½
Sanitary Engineering	214, 215	2	1½	2	3
Thesis and Public Speaking*	730	–	–	–	1
And either of the following groups of subjects:					
Group A					
Mechanics of Materials	38	–	3	–	3
Soil Mechanics and Foundations	40, 50	2	–	2	3
Structural Design	43, 54	1	3	1	3
Theory of Structures	36, 37	2	1½	2	1½
Group B					
Adjustment of Observations	523	–	–	–	3
Astronomy	202, 203	1	3	–	–
Geodesy	204, 205	–	–	2	3
Photogrammetry	77, 78	1	3	1	3
Soil Mechanics and Foundations	49, 50	1	–	1	3
Survey Camp	721	–	–	–	–
Town and Regional Planning	219, 220	1	3	–	–

*Topic for Thesis must be submitted by each student for approval not later than Oct. 15, and preferably by the beginning of the first term. The final date for submission of completed, typed thesis is the last day **of the first term.**

MINING ENGINEERING

(Course 2)

The Mining Engineer is concerned with all aspects of the winning of metals and minerals from their geological environments in the earth's crust, and of their conversion to forms in which they can best be utilized in the growing needs and comforts of man. Thus, the course in Mining Engineering has been designed to prepare its graduates for successful participation in the engineering, operational, and administrative activities of those aspects.

The professional fields concerned include mineral exploration, evaluation and development of mineral properties, the mining of ores from a multiplicity of geological situations by the most advanced methods, the treatment of ores in beneficiating and metallurgical plants, and the economics of mineral markets. For the enhancement of abilities in supervision and management, the administrative viewpoint and attitude are stressed in the professional subjects during the later years of the course.

Building upon a foundation in the disciplines of mathematics, physics, and chemistry, the student proceeds through training in geology, mechanics, electricity, economics, business, and general engineering subjects, to a growing proportion of specifics dealing with the fields which the course is designed to serve. The diversification of this training renders the Mining Engineer capable of successful participation in all branches of industry and commerce.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.* Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	227	–	6	–	–
Calculus	491, 287	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Chemistry	224	2	–	–	–
Economics	311	2	–	2	–
Electric Circuits and Machines	347, 348	1	–	2	$1\frac{1}{2}$
Historical and Stratigraphic Geology	393	–	–	2	1
Mechanics of Materials	23, 31	2	–	2	3
Mineralogy and Lithology	386, 387	2	2	2	2

Second Year Subjects Course 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Mining	165	–	–	1	2
Oral Expression	193	–	–	–	2
Physical Geology	380, 381	2	3	–	–
Practical Experience	690	–	–	–	–
Surveying	715, 717	1	3	2	2

Third Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 161	1	3	1	3
Business	310	–	–	1	–
Elementary Structural Engineering	29, 53	1	–	2	3
Fluid Flow and Pumping Systems	454, 455	3	3	–	–
Geological Field Work	411	–	–	–	–
Heat Engines, Theory	427, 428	1	–	1	3
Metallurgy	539	–	–	1	–
Mineral Dressing	180, 182	2	–	2	6
Mining	168	3	–	–	–
Mining Laboratory	169	–	3	–	3
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–
Structural Geology	397, 398	1	3	1	3
Summer Essays	192	–	2	–	–
Survey Camp	720	–	–	–	–
Wet Analysis	162	–	3	–	3

Fourth Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Glacial Geology and Ground Water	384, 412	1	–	1	–
Machine Design	469, 470	1	–	1	3
Metallurgy	555, 556	1	–	1	3
Mine Operation and Administration	170, 172	2	2	2	6
Mineral Deposits	399	2	–	2	–
Mine Ventilation	175, 176	2	3	–	–
Mining Geology	405	–	–	2	–
Ore Dressing	183, 184	1	6	1	–
Physical Metallurgy	538	–	–	2	–
Practical Experience	690	–	–	–	–
Precambrian Geology	403	2	1	–	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	5½	–	6

MECHANICAL ENGINEERING

(Course 3)

The mechanical engineer is concerned with the production and the use of power, and it is part of his work to design and manufacture suitable machinery for this purpose, and to install and operate it. The internal combustion engine and the steam turbine are the products of his effort, and he applies these prime movers to automobiles, aeroplanes, locomotives, and other purposes. His work also includes the design of water turbines and their use in hydro-electric systems.

Other branches of his work are the making of designs for air compressors, machine tools, pumps, refrigerating machines and their application to storage warehouses and ice-making, heating and ventilating equipment, materials-handling and conveying plants, and generally all mechanical work. General industrial and administrative problems are considered.

The course of study has been devised to equip men for work in the general field of mechanical engineering.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	367, 368	2	1½	–	–
Calculus....................	491	2	–	2	–
Dynamics of Machines........	465, 466	3	1½	3	1½
Economics..................	311	2	–	2	–
Electricity..................	338, 334	–	–	2	3
Engineering Chemistry........	226	2	–	–	–
Engineering Problems and Drawing...............	286	–	6	–	6
Heat Engines, Elementary.....	420	–	–	2	–
Mechanical Engineering.......	461	1	–	–	–
Mechanics of Materials.......	23, 31	2	3	2	–
Physical Metallurgy..........	564, 565	2	–	2	1½
Practical Experience..........	690	–	–	–	–
Treatment of Technical Data..	449	–	–	2	–

Third Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Business	310	–	–	1	–
Differential Equations	511	2	1½	2	3
Electronics	345, 346	2	1½	–	–
Electrical Machines	377, 378	2	1½	2	3
Engineering Thermodynamics	421, 423	2	3	2	3
Fluid Mechanics	440, 441	2	–	2	3
Heat Engineering	422	2	–	1	–
Machine Design	467, 468	2	4½	2	6
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–

Fourth Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Engineering	520	1	3	2	2
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Heat Power Engineering	424, 426	2	3	2	5
Hydraulics	443, 444	2	3	2	5
Industrial Management	315	1	–	–	–
Internal Combustion	425	1	–	1	–
Machine Design	473, 474	2	3	2	5
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Structural Engineering	30, 296	2	3	2	3
Thesis	730	–	1	–	1

INDUSTRIAL ENGINEERING

(Course 4)

The Industrial Engineering course, like the other engineering courses at the University of Toronto, is primarily an education for the profession of engineering. The student is given a substantial foundation in science and mathematics, and in such fundamental engineering subjects as fluid mechanics, applied thermodynamics, electricity, mechanics of materials and machine design.

At the same time, the Industrial Engineering student undertakes a specialization in industrial and engineering analysis. This includes studies in probability and statistics, numerical analysis, operations research, data processing and control theory. Emphasis is placed on the application of these methods in both the economic and technical aspects of industry, and in automatic systems. The student is also introduced to such studies as organizational structure, financial control and industrial psychology.

The course in Industrial Engineering has superseded the course in Engineering and Business.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	367, 368	2	$1\frac{1}{2}$	–	–
Calculus....................	491	2	–	2	–
Dynamics..................	22	–	–	2	–
Economics..................	311	2	–	2	–
Electricity..................	338, 334	–	–	2	3
Engineering Chemistry........	226	2	–	–	–
Engineering Problems and Drawing..................	288	–	6	–	6
Mechanical Engineering.......	463, 464	2	–	2	3
Mechanics of Materials.......	23, 31	2	3	2	–
Practical Experience..........	690	–	–	–	–
Probability and Statistics.....	512, 513	2	3	2	3
Physical Metallurgy..........	564, 565	2	–	2	$1\frac{1}{2}$

Third Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Accounting..................	306	2	–	2	–
Differential Equations........	511	2	–	2	–
Electronics..................	345, 346	2	$1\frac{1}{2}$	–	–
Elementary Structural Engineering................	29, 53	1	–	2	3
Fluid Mechanics.............	440, 441	2	3	2	–
Heat Engines, Theory........	435, 423	–	–	2	3
Industrial Psychology.........	327	–	–	2	–
Machine Design..............	467, 468	2	3	2	3
Modern World History........	324	2	–	2	–
Numerical Analysis...........	514, 515	2	3	2	3
Practical Experience..........	690	–	–	–	–

Fourth Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Elementary Control Theory	480, 481	2	3	2	3
Electric Machines	342, 343	2	3	–	–
Engineering Data Processing	678, 679	2	3	–	–
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Industrial Management	320, 322	2	3	2	3
Manufacturing Processes	476, 477	–	–	2	3
Operations Research I	524, 525	2	3	2	3
Operations Research II	526, 527	–	–	2	3
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Thesis	730	–	2	–	2

ENGINEERING PHYSICS

(Course 5)

Admission to and promotion in this course is granted only to students who meet the special requirements set forth on page 20 of this Calendar.

The course is designed to afford a training in Mathematics and Physics beyond that which it is possible to give in the other undergraduate courses in engineering. It is believed that a wider and more thorough acquaintance with the basic sciences will bring to the student a readier appreciation of the nature of the technical problems with which he will later be confronted and a greater facility in the solution of them. A course of the kind offered should consequently be of particular value to those who desire to enter governmental or industrial research laboratories, or who wish to engage in any original work of investigation or development in the field of applied physics.

Throughout the four years of the course an effort is made to maintain the practical point of view in the theoretical instruction. This is effected, in part, by adopting wherever possible the engineering viewpoint in the teaching of mathematical and scientific subjects, and, in part, by the inclusion of certain basic engineering instruction.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION C, see page 32.

Second Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Calculus	504	2	–	2	–
Dynamics	25	1	–	1	–
Economics	311	2	–	2	–
Electric Circuits	354, 356	2	1½	2	1½
Inorganic Chemistry	237	2	–	1	–
Integral Calculus and Differential Equations	505	2	–	2	–
Mathematical Problems	495	–	3	–	3
Mechanics of Materials	24, 31	2	–	1	3
Physical Chemistry	238	1	–	2	–
Physics	652, 655	3	6	3	3
Probability and Numerical Methods	501	2	–	2	–

Third Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mechanics	27	2	–	2	–
Differential Equations	509	1	1	1	1
Electronics	366, 379	2	–	2	1½
Modern World History	324	2	–	2	–
Physical Laboratory	659	–	3	–	3
Thermodynamics and Kinetic Theory	657	2	–	2	–
Theory of Functions	508	1	1	1	1

And *one* of the following options which must be continued in the Fourth Year.

Option 5a, Aeronautics/ Astronautics					
Mechanics of Solids and Structures	7, 8	2	3	2	3
Fluid Mechanics	12, 15	2	3	2	3
Physical Metallurgy	561	1	–	1	–
Option 5c, Chemical					
Chemical Theory B	240	2	–	2	–
Chemical Laboratory	249	–	6	–	6
Crystallography	390	1	–	1	–
Fluid Mechanics	12, 15	2	1½	2	1½
Physical Metallurgy	561	1	–	1	–
Option 5e, Electricity					
Acoustics	97, 98	2	1½	–	–
Electrical Machines	377, 378	2	1½	2	3
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	561	1	–	1	–
Physics of Solids and Fluids	656	1	–	1	–
Option 5g, Geophysics					
Physical Geology	380, 413	2	–	–	–
Mineralogy and Lithology	386, 387	2	2	2	2
Physical Metallurgy	561	1	–	1	–
Physics of Solids and Fluids	656	1	–	1	–
Physics of the Earth	674	1	–	1	–
Structural Geology	397, 398	1	3	1	3
Option 5m, Physical Metallurgy					
Crystallography	390	1	–	1	–
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	533, 534	2	3	2	3
Physics of Solids and Fluids	656	1	–	1	–
Option 5n, Atomic Energy					
Machine Design	471, 472	1	3	1	3
Nuclear Physics	662	1	–	1	–
Physical Metallurgy	561, 534	1	3	1	3
Fluid Mechanics	12, 15	2	1½	2	1½
Option 5s, X-Rays and Spectroscopy					
Crystallography	390	1	–	1	–
Machine Design	471, 472	1	3	1	3
Optics I	660, 661	1	3	1	–
Physical Metallurgy	561	1	–	1	–
Physics of Solids and Fluids	656	1	–	1	–
Option 5t, Thermodynamics					
Fluid Mechanics	12, 15	2	1½	2	1½
Heat Engineering	438, 423	2	3	2	3
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	561	1	–	1	–

Students in Engineering Physics are required to state at the beginning of the Third Year the options they desire to pursue in the Third and Fourth Years. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Fourth Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5a, Aeronautics					
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Engineering Design	3, 4	2	3	2	3
English	611	1	–	1	–
Gasdynamics	13, 16	2	1½	1	3
Mechanics of Solids and Structures	5, 6	2	3	2	3
Philosophy of Science	326	2	–	–	–
Plasmadynamics	9, 10	1	–	2	1½
Thesis	730	–	–	–	–
Transport Phenomena	1	1	–	1	–
Option 5c, Chemical					
Atomic Physics	663	3	–	3	–
Chem. Eng. Laboratory	252	–	6	–	9
Chem. Eng. Thermodynamics and Kinetics	256	2	–	2	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Diffusion and Mass Transfer	261	2	–	2	–
English	611	1	–	1	–
Organic Chemistry	250, 258	2	3	2	–
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5e, Electricity					
Atomic Physics	663	3	–	3	–
Circuit Analysis	350	2	–	2	–
Communications I	360, 361	3	3	–	–
Communications II	362, 363	–	–	3	3
Communications III	371	–	–	2	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electric Control Systems	357, 358	2	1½	1	1½
English	611	1	–	1	–
Electromagnetic Theory, Applied	365	2	–	2	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	–	–	–
Option 5g, Geophysics					
Atomic Physics	663	3	–	3	
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Geophysical Methods	670, 672	2	6	2	6
Glacial Geology	384	1	–	1	–
Mineral Deposits	399	2	–	2	–
Petroleum Geology	407, 408	2	–	2	3
Philosophy of Science	326	2	–	–	–
Physics of the Earth	675	1	–	1	–
Thesis	730	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5m, Physical Metallurgy					
Atomic Physics	663	3	–	3	–
Communications I	360, 361	3	3	–	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Metal Physics Seminar	563	–	3	–	3
Operational Methods	364	2	–	2	–
Physical Metallurgy	557, 562	2	–	2	3
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–
X-Ray Crystallography	415	–	–	2	–
Option 5n, Atomic Energy					
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electric Control Systems	357, 358	2	1½	1	1½
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Gasdynamics	13, 16	2	1½	1	3
Heat Transfer	433	–	–	2	–
Nuclear Engineering	664	1	–	1	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–

FOURTH YEAR SUBJECTS COURSE 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Options 5s, X-Rays and Spectroscopy					
Atomic Physics	663	3	–	3	–
Communications I	360, 361	3	3	–	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Operational Methods	364	2	–	2	–
Optics II	666	2	–	2	–
Philosophy of Science	326	2	–	–	–
Physical Laboratory	665	–	9	–	9
Quantum Mechanics	669	1	–	1	–
Thesis	730	–	–	–	–
Option 5t, Thermodynamics					
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
English	611	1	–	1	–
Gasdynamics	13, 16	2	1½	1	3
Heat Engineering Laboratory	426	–	3	–	3
Heat Power Engineering	430	1	–	1	–
Heat Transfer	433	–	–	2	–
Refrigeration and Air Conditioning	429	2	–	–	–
Internal Combustion	436	1	–	1	–
Machine Design	478	–	–	2	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	–	–	–
Vibration Engineering	99, 100	1	3	1	3

CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(Course 6)

The chemical engineer is concerned with the development and operation of processes by means of which matter is chemically altered to a more useful form, and in the design, construction, operation and management of plant in which to effect such changes. Apart from such obviously chemical processes as those concerned with the production of acids, alkalis, salts, petroleum, rubber products, pulp and paper, explosives, paints and varnishes, soap, plastics, etc., there are many industrial processes where chemistry plays a part, or where a knowledge of chemistry is valuable. There is thus a wide field of endeavour for the chemical engineer. In order to equip a student to enter this field, the course in chemical engineering is intended to provide the student with training in the principles of the major divisions of chemistry and chemical engineering, together with an understanding of such other engineering subjects as thermodynamics, hydraulics, electricity, mechanics of materials, and machine design.

As part of the work of the Fourth Year each student is assigned a problem involving original investigation, in order to let him apply to some extent what he has learned, and to introduce him to the chemical literature. It also serves as an introduction to research for those who are attracted to it, and who, because of their basic training are equipped to carry on research in chemistry or chemical engineering at the graduate level or in laboratories outside the university.

For those students considering taking up the teaching of science as a profession, the nature and extent of the thesis subject in the Fourth Year may be modified to allow the student to take such other instruction as may be necessary to shorten the time required before becoming professionally qualified.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	232, 233	2	9	–	–
Analytical Chemistry Laboratory	229	–	–	–	–
Calculus	491, 287	2	1½	2	1½
Chemical Engineering Science Laboratory	235	–	–	–	12
Economics	311	2	–	2	–
Electrical Engineering	375, 376	2	3	2	3
Industrial Chemistry	230	2	–	1	–
Inorganic Chemistry	231	1	–	2	–
Mechanics of Materials	23	2	–	2	–
Organic Chemistry	234	1	–	2	–
Physical Chemistry	236	2	–	2	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory	249	–	6	–	6
Chemical Theory A	239	1	–	1	–
Chemical Theory B	240	2	–	2	–
Differential Equations	507	1	–	1	–
Fluid Mechanics	452, 453	2	3	–	–
Heat Engines, Theory	431, 423	2	–	–	3
Industrial Chemistry	241	–	–	3	–
Introduction to Mass and Heat Transfer	242	2	–	2	3
Modern World History	324	2	–	2	–
Organic Chemistry	244, 245	2	9	2	6
Practical Experience	690	–	–	–	–
Public Speaking	319	–	1	–	1

Fourth Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Chemical Engineering	255	–	3	–	–
Chemical Engineering Thermodynamics and Kinetics	256	2	–	2	–
Chemical Engineering Laboratory	251	–	10	–	–
Chemical Plant Design	254	1	–	–	3
Electrochemistry	246, 247	2	$1\frac{1}{2}$	–	–
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Industrial Management	315	1	–	–	–
Machine Design	479, 470	2	–	1	3
Mass Transfer Operations	253	2	–	2	–
Organic Chemistry	257	1	–	1	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	3	–	18

ELECTRICAL ENGINEERING

(Course 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields in addition to that of applying things electrical for the benefit of humanity. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also heat engines, hydraulics, theory of mechanisms, machine design, business, economics, engineering law, and other non-electrical subjects.

In the electrical field much time is given to the calculation of circuits of electric, magnetic, and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets, and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial, or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Physics	70, 71	–	–	2	3
Chemistry	225	2	–	–	–
Calculus and Differential Equations	493	2	2	2	2
Dynamics	26, 32	2	$1\frac{1}{2}$	1	$1\frac{1}{2}$
Economics	311	2	–	2	–
Electric Circuits I	332	3		3	
Electric and Magnetic Fields	333	2	2	2	2
Electrical Measurements	340	–	–	2	–
Electrical Laboratory	334	–	3	–	3
Mechanics of Materials	24, 31	2	3	1	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Business	310	–	–	1	–
Electric Circuits II	341	3	–	3	–
Electric Machinery I	339	2	–	1	–
Electronics	337	2	–	3	–
Electrical Problems	335	–	4	–	4
Electrical Laboratory	344	–	3	–	3
Electronics Laboratory	379	–	–	–	3
Heat Engineering Laboratory	423	–	3	–	–
Machine Design	475, 468	2	3	–	–
Mathematics	336	2	2	2	2
Modern World History	324	2	–	2	–
Physical Metallurgy	566, 567	–	–	2	1½
Practical Experience	690	–	–	–	–
Thermodynamics	437	2	–	1	–

Fourth Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Machinery I	353	3	–	–	–
Circuit Analysis	351	2	–	3	–
Communications I	360, 361	3	3	–	–
Electrical Laboratory	355	–	3	–	1½
Electrical Problems and Seminar	359	–	2	–	2
Electric Control Systems	357, 358	2	1½	2	1½
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Industrial Management	315	1	–	–	–
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Thesis	730	–	–	–	–
Transmission at Low and High Frequencies	352	3	–	–	–
And one of the following groups of subjects:					
Group A					
Acoustics	82, 83	–	–	2	1½
Communications II	362	–	–	3	–
Communications III	371	–	–	2	–
Communications Laboratory	363	–	–	–	3
Group B					
Alternating-Current Machinery II	369, 370	–	–	2	1½
Electric Power Systems	373	–	–	2	2
Illumination	93, 94	–	–	2	3

METALLURGICAL ENGINEERING

(Course 8)

No other materials approach the metals in strength, and the whole fabric of modern civilization is dependent on their properties. The fields of employment for graduates lie in production metallurgical industries, the industries which fabricate metals, and in sales and research. Metallurgical research facilities have notably been increased in recent years in Canada.

The metallurgical engineer is concerned with the winning of metals from ores. Since virgin metals rarely possess useful physical properties, the second task of the metallurgist is to produce alloys, such as steel, which have suitable physical properties.

Both physical and extractive metallurgy are based upon the sciences of chemistry and physics. It is believed that a wider knowledge of the basic sciences will bring to the student a readier appreciation of the technical problems with which he will be later confronted and a greater facility in their solution. To achieve this end, greater emphasis is placed upon physics and chemistry in the earlier years of the course. It follows that this course will be of greater value to students who have obtained a good standing in mathematics and science. In addition to instruction in extractive and physical metallurgy, engineering subjects are provided to give a general knowledge of mechanics of materials, machine design, etc. The course includes the non-technical subjects, such as Economics and English, which are common to all courses in the Faculty.

Courses in production metallurgy cover the theory and practice of winning aluminium, copper, iron, lead, magnesium, nickel, zinc, etc., from their ores. Physical Metallurgy courses cover the structure and properties of alloys, including microscopic, x-rays and mechanical methods of investigation.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	228	–	4	–	4
Calculus	491	2	–	2	–
Economics	311	2	–	2	–
Electrical Engineering	375, 376	2	3	2	3
Engineering Problems and Drawing	289	–	3	–	3
Inorganic Chemistry	231	1	–	2	–
Mechanics of Materials	23, 31	2	3	2	–
Metallurgy	530	2	–	2	–
Metallurgy Problems	540	–	–	–	2
Optics	72, 73	1	3	1	3
Physical Chemistry	236	2	–	2	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 164	1	3	1	–
Crystallography	390	1	–	1	–
Differential Equations	507	1	–	1	–
Electrochemistry	246, 247	2	1½	–	–
Metallurgical Problems Laboratory	536	–	4	–	4
Metallurgical Thermodynamics I	535	2	–	2	–
Mineral Dressing	180, 181	2	–	2	6
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–
Principles of Extractive Metallurgy	531, 532	2	3	2	6
Principles of Physical Metallurgy	533, 534	2	3	2	3

Fourth Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Extractive Metallurgy Laboratory	552	–	6	–	–
Ferrous Extractive Metallurgy	551	1	–	1	–
Fluid Mechanics	452	2	–	–	–
Heat Transfer	432	–	–	2	–
Machine Design	469, 470	1	–	1	3
Metallurgical Thermodynamics II	553	2	–	2	–
Metallurgical Problems Laboratory	554	–	2	–	2
Non-Ferrous Extractive Metallurgy	550	1	–	1	–
Ore Dressing	183	1	–	1	–
Philosophy of Science	326	2	–	–	–
Physical Metallurgy	557, 558	2	6	2	3
Practical Experience	690	–	–	–	–
Statistics	510	2	–	–	–
Thesis	730	–	3	–	12

APPLIED GEOLOGY

(Course 9)

The expanding Canadian economy is making ever growing demands on the Mineral Industry for raw products—iron, copper, uranium, gas, petroleum, etc. Geologists play an important part in this industry. They belong to a team—whose other members are mining engineers and metallurgists—responsible for finding new deposits of metals, mining them, and extracting the metals from the ores. In addition, geologists are widely employed in the petroleum industry.

The course in Applied Geology provides a training in the fundamentals of the geological sciences and graduates in this course are suitably trained to enter the ranks of professional geologists. Students also take work with related departments, such as Mining Engineering, Metallurgical Engineering, Chemical Engineering and Civil Engineering, and in this way have some knowledge of other fields of engineering.

The geological subjects are selected so that they will carry the student through from an introductory course to a stage where he has a useful knowledge of the broad field of the subject. He is properly trained to find employment in mining geology, petroleum geology, or engineering geology. Such work may be with exploration companies, oil companies or mining companies.

Graduates in Applied Geology who wish further specialized training in geology may proceed to the M.A.Sc. or Ph.D. degrees, and thus qualify themselves for employment with government geological surveys or as university teachers.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 86.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	227	–	6	–	–
Calculus	491, 287	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Chemistry	224	2	–	–	–
Economics	311	2	–	2	–
Historical and Stratigraphical Geology	393, 394	–	–	2	3
Mechanics of Materials	23, 31	2	–	2	3
Mineralogy and Lithology	386, 387	2	2	2	2
Mining	165	–	–	1	2
Optics	72, 73	1	3	1	3
Oral Expression	193	–	–	–	2
Physical Geology	380, 381	2	3	–	–
Practical Experience	690	–	–	–	–
Surveying	715, 717	1	3	2	2

Third Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 161	1	3	1	3
Business	310	–	–	1	–
Descriptive Mineralogy	388	–	2	–	2
Elementary Geochemistry	385	2	–	2	–
Geological Field Work	411	–	–	–	–
Metallurgy	539	–	–	1	–
Mineral Dressing	186	2	–	–	–
Mining	168	3	–	–	–
Modern World History	324	2	–	2	–
Ore Microscopy	389	–	–	–	3
Palaeontology	395, 396	2	2	2	2
Petrology	391, 392	3	2	2	2
Practical Experience	690	–	–	–	–
Stratigraphy and Sedimentation	409, 410	–	–	2	2
Structural Geology	397, 398	1	3	1	3
Survey Camp	720	–	–	–	–

Fourth Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Geology of Canada	401	1	–	1	–
Geological Field Trips	412, 414	–	–	–	–
Geophysics	671, 673	1	3	1	3
Metallurgy	555	1	–	1	–
Mineral Deposits	399, 400	2	–	2	3
Mine Operation and Administration	170, 173	2	–	2	3
Mining Geology	405, 406	–	3	2	–
Petroleum Geology	407, 408	2	–	2	3
Pleistocene Geology	402	2	–	2	–
Practical Experience	690	–	–	–	–
Precambrian Geology	403, 404	2	3	–	3
Philosophy of Science	326	2	–	–	–
Thesis	730	–	6	–	–

AERONAUTICAL/ASTRONAUTICAL ENGINEERING

A five year program of study has been designed to prepare the student for a career in aeronautical/astronautical engineering. It includes the following elements: (a) an introduction to the fundamentals of mathematics, physics, and chemistry, (b) an introduction to aerodynamics, instrumentation, propulsion, structures and design, and (c) an advanced treatment of the subjects required for modern design and research in aeronautics/astronautics such as hypersonic aerodynamics, flight dynamics, and space propulsion. Under (a) and (b) the student's training is necessarily broad and basic. The more advanced knowledge needed for the research, development, and design relevant to new aircraft and spacecraft is provided under (c) and is of particular significance. It is possible to provide (a) and (b) in a four-year undergraduate course, but the final intensive training under (c) must be left for a graduate year.

The program of study that leads to status as a well-qualified aeronautical/astronautical engineer has been established in two parts as follows:

(i) *Undergraduate Course.* The student registers in the course in Engineering Physics, subject to the entrance requirements given on page 20 of this Calendar. This course provides the requisite training in the fundamental sciences (see (*a*) above). The advanced subjects contained in the Aeronautics/Astronautics option given in the third and fourth years are taught by the staff of the Institute of Aerophysics (see (*b*) above). The student will receive the degree of Bachelor of Applied Science upon completion of this part of the program.

(ii) *Graduate Course.* The student will then continue his five year program (*see* (*c*) above) in the Department of Aeronautical Engineering and Aerophysics, School of Graduate Studies, as a candidate for the degree of Master of Applied Science in Aeronautical/Astronautical Engineering. During this year the student has a choice of taking one of two options consisting of at least four courses and a review thesis or at least two courses and a research or development thesis. Details regarding entrance regulations and courses of study are given in the Calendar of the School of Graduate Studies. The facilities of the Institute of Aerophysics are available to the student. For details of research projects, assistantships, scholarships and demonstratorships, students should consult the Director of the Institute of Aerophysics.

It should be noted that a student who has graduated in another branch of engineering and who desires to qualify as an aeronautical/astronautical engineer may proceed directly with (ii) above, but in this case the course leading to the M.A.Sc. degree must be arranged so that deficiencies in his undergraduate training are made up.

The facilities of the Institute of Aerophysics are available for further graduate study leading to the Ph.D. Degree.

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 221, Chemistry, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 32.

Where laboratory reports are to be written outside of assigned laboratory hours, the maximum number of such reports is indicated in the description of the laboratory course concerned.

INSTITUTE OF AEROPHYSICS

1. Transport Phenomena. B. Etkin.

Course 5a, IV year: 1 hr. lecture per week, both terms.

A fundamental treatment of selected phenomena in fluid dynamics in which the transport of momentum, mass and energy are the key underlying processes, i.e. dynamics of viscous fluids; boundary layers; turbulence; diffusion.

Reference book: Transport Phenomena—Bird, Stewart and Lightfoot.

3. Engineering Design. R. D. Hiscocks.

Course 5a, IV Year; 2 hrs. lectures per week, both terms.

An introduction to the principles of design; the origin of a design requirement; loading, performance and other criteria; typical design specifications.

The process is examined by which the design is synthesized from the design specification and various other related data.

Selection of material; type of structure and fabrication technique.

Certain important aspects of design are examined in detail. These include the design of riveted, bolted, glued and welded joints, the design of cast and forged structural components, the fatigue life of structures and "fail safe" principles.

The course is illustrated throughout by reference to typical design problems, some of which are solved by the students.

4. Engineering Design Laboratory. R. D. Hiscocks.

Course 5a, IV year; 3 hrs. laboratory per week, both terms.

Design projects based on the lectures in subject 3 are assigned. Design drawings, and engineering reports are prepared by the students.

5. Mechanics of Solids and Structures. E. D. Poppleton.

Course 5a, IV year; 2 hrs. lectures per week, both terms.

A continuation of subject 7 to a more advanced level; structural stability; thermal stresses; structural vibrations and wave propagation.

Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

6. Mechanics of Solids and Structures Laboratory. E. D. Poppleton.
Course 5a, IV year; 3 hrs. laboratory per week, both terms.
Problems and experiments related to subject 5.

7. Mechanics of Solids and Structures. E. D. Poppleton.
Course 5a, III year; 2 hrs. lectures per week, both terms.
A discussion of the structure of solids and the mechanics of their deformation. An introduction to the classical theories of elasticity and plasticity with application to the analysis of simple structures.
Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

8. Mechanics of Solids and Structures Laboratory. E. D. Poppleton.
Course 5a, III year; 3 hrs. laboratory per week, both terms.
Problems and experiments related to subject 7.

9. Plasmadynamics. J. H. de Leeuw.
Course 5a, IV year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
Review of electric and magnetic fields. Derivation of Maxwell's equations. Thermodynamics and equations of motion of an electrically conductive medium. Simple examples of the influence of a magnetic field on the motion of an electrically conductive medium.

10. Plasmadynamics Laboratory. J. H. de Leeuw.
Course 5a, IV Year; 3 hrs. laboratory alternate weeks, second term.
Problems and experiments based on the lecture material of subject 9.

12. Fluid Mechanics. G. K. Korbacher.
Courses 5a, 5c, 5n, 5t, III Year; 2 hrs. lectures per week, both terms.
Introductory aerodynamics; calculus of vector fields; inviscid flow equations; examples of incompressible fluid flow including applications of complex variables; fundamentals of compressible flow; viscous flows including drag and boundary layers.
Reference book: Foundations of Aerodynamics (2nd ed.)—Kuethe and Schetzer.

13. Gasdynamics. I. I. Glass.
Courses 5a, 5n and 5t, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Introductory thermodynamics of perfect and imperfect gases, equations of motion and their application to nozzles, diffusers and supersonic wind tunnels; expansion waves; normal, oblique and conical shock waves; skin friction and heat transfer in boundary layers and ducts; aerodynamic measurements.
Reference books: Elements of Gasdynamics—Liepmann and Roshko. Dynamics and Thermodynamics of Compressible Fluid Flow—Shapiro. An Introduction to Fluid Mechanics and Heat Transfer—Kay.

15. Fluid Mechanics Laboratory. G. K. Korbacher.

Course 5a, III Year; 3 hrs. laboratory per week, both terms.

Courses 5c, 5n, 5t. III Year; 3 hrs. laboratory alternate weeks, both terms.

Problems and experiments based on the lectures of subject 12.

16. Gasdynamics Laboratory. I. I. Glass.

Courses 5a, 5n and 5t, IV Year; 3 hrs. laboratory alternate weeks. first term; 3 hrs. laboratory per week, second term.

Problems and experiments based on subject 13 are given to illustrate principles of gas dynamics and the measurement of physical quantities.

APPLIED MECHANICS AND DESIGN OF STRUCTURES

20. Applied Mechanics. A. C. Davidson, M. M. Davis, D. J. L. Kennedy, J. Schwaighofer, K. Meipoom, S. M. Uzumeri, G. T. Will, J. Timusk.

Courses 1, 2, 3, 4, 6, 7, 8, and 9, I Year; 2 hrs. lectures per week, both terms.

This subject is divided into two parts, statics and dynamics.

Statics: The principles of statics are discussed, and applied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and the bending moments and shearing forces in beams.

Dynamics: Principles of dynamics, and application to motion of particles on straight and curved paths—work, energy, power, impulse and momentum. Plane translation and rotation of rigid bodies.

Six 3-hr. practice problem periods during the Session are provided in the 3 hr. laboratory time shown on page 31 for subjects 20, 330, and 677. Problems must be done during the laboratory period.

Text books: Applied Statics—Loudon, Morrison and Davidson. Engineering Mechanics—Vol. II—Dynamics—Higdon and Stiles—Second Edition. Mechanics for Engineers—Dynamics—Beer and Johnston. Each lecturer will indicate which text will be used by his class.

21. Statics. R. A. Collins, J. D. Barber.

Course 5, I Year; 2 hrs. lectures per week, first term.

The principles of statics are discussed, and applied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and the bending moments and shearing forces in beams.

Text book: Applied Statics—Loudon, Morrison and Davidson.

22. Dynamics. G. E. Godfrey, F. P. J. Rimrott.

Course 1, II Year; 1 hr. lecture per week, both terms.

Course 4, II Year; 2 hrs. lectures per week, second term.

Motion of a point is reviewed and extended to include Coriolis' acceleration, with applications. Equations for motion of mass in translation, rotation, and plane motion are developed, including centre of percussion. Moment of inertia of mass is studied by double integration and by the lamina method. The derivation and application of gyroscopic action is thoroughly discussed, and an introduction to static and dynamic balancing is given. Elementary vibration theory and problems in vibration isolation are discussed.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics—Part II—Meriam.

23. Mechanics of Materials. J. D. Barber, M. M. Davis, F. A. De Lory, D. J. L. Kennedy, K. Meipoom, S. M. Uzumeri.

Courses 1, 2, 3, 4, 6, 8, and 9, II Year; 2 hrs. lectures per week, both terms.

In this subject, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pipes and tanks, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Text book: Elements of Strength of Materials—Timoshenko and MacCullough—Third Edition.

24. Mechanics of Materials. R. A. Collins, A. C. Davidson.

Courses 5 and 7, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Basic relationships between force, stress, strain, and deflection of bodies made of various engineering materials are discussed. Beams, columns, shafts, tension members and pressure vessels are analysed and designed for strength and stiffness.

Text book: Elements of Strength of Materials—Timoshenko and MacCullough.

25. Dynamics. F. C. Hooper.

Course 5, II year; 1 hr. lecture per week, both terms.

Simple particle motion. Work and energy. Impulse and momentum. Kinematics of plane motion and Coriolis acceleration. Kinetics of translation and rotation. General kinetics of plane motion. Gyroscopic action. Simple vibrations. Gibbs' Vector Notation.

Reference books: Engineering Dynamics—Hooper and Smith. Mechanics—Part II Dynamics—Meriam.

26. Dynamics. C. L. Proctor.

Course 7, II Year; 2 hrs. lectures per week first term; 1 hr. lecture per week, second term.

Motion of a point, including Coriolis' acceleration; motion of mass; gyroscopic action; vibration and balancing; electro-mechanical analogies; Gibb's vector notation.

Text book: Engineering Dynamics—Hooper and Smith.

Reference books: Part II—Meriam. Engineering Mechanics—Shames.

27. Advanced Mechanics. H. S. Ribner.

Course 5, III Year; 2 hrs. lectures per week, both terms.

Mechanics of particles: fixed axes, rotating and moving axes, rectilinear motion of rockets, orbital dynamics. Mechanics of rigid bodies: fixed axes, body-attached axes (Euler's equations), gyroscopes. Dynamics of linear systems: free and forced oscillations, coupled systems, waves on a string, Rayleigh's method for continuous systems. Lagrange's equations. Introduction to wave mechanics.

Reference books: Introduction to Theoretical Physics—Page. Principles of Mechanics—Synge & Griffith.

28. Structural Engineering. C. F. Morrison.

Course 1, III Year; 2 hrs. lectures per week, both terms.

An elementary study of the stress analysis and design of structures, structural members, and their details. Problems in analysis and design are worked out in the lectures and in the drafting room.

The work covered includes static and moving loads, steel and timber tension members, compression members and flexural members including box-girders, plate girders and continuous as well as simple span beams. Welding as a method of connecting structural steel members is studied.

Text books: Theory of Simple Structures—Shedd and Vawter. Structural Problems—Young and Morrison. Steel Construction Handbook—A.I.S.C.

29. Elementary Structural Engineering. A. C. Davidson.

Courses 2 and 4, III Year; 1 hr. lecture per week first term; 2 hrs. lectures per week, second term.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject No. 53).

Text books: Design of Steel Structures—Gaylord & Gaylord. Steel Construction Manual—American Institute of Steel Construction. National Building Code of Canada—National Research Council, Ottawa. Timber Construction Manual—Canadian Institute of Timber Construction. Basic Reinforced Concrete Design—Large.

30. Structural Engineering. A. C. Davidson.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject 52).

The work covered comprises: Moving loads in simply supported beams; in steel, tension and compression member details, columns, rolled steel beams, built-up beams and girders; in wood, beams, columns, and their connections; in concrete, the making of plain concrete, reinforced concrete beams, columns, slabs and footings.

Text books: Design of Steel Structures—Gaylord & Gaylord. Steel Construction Manual—American Institute of Steel Construction. National Building Code of Canada—National Research Council, Ottawa. Timber Construction Manual—Canadian Institute of Timber Construction. Basic Reinforced Concrete Design—Large.

31. Mechanics of Materials: General. W. L. Sagar, C. E. Helwig, C. W. Dillane, J. D. Barber.

Courses 1, 2, 5 and 9, II Year; 3 hrs. laboratory per week, second term.

Courses 3, 4, 7, and 8, II Year; 3 hrs. laboratory per week, first term.

An introduction to testing machines, strain and other measuring devices and standard specifications.

The experimental study of some engineering materials and structural members under external load.

No laboratory report shall be written outside the assigned teaching hours.

32. Dynamics Laboratory. C. L. Proctor.

Course 7, II Year; 1½ hrs. problems per week, both terms.

Problems in kinematics and kinetics to support subject 26.

33. Applied Elasticity. J. Schwaighofer.

Course 1, III Year; 1 hr. lecture per week, both terms.

A study of the stresses and strains in structural materials and members. The topics treated include: members subjected to direct stress, shear stress, and flexural stress, and their resulting deformations; principal stresses; statically indeterminate structures such as continuous and fixed-end beams; the moment-area theorems.

Reference books: Elements of Strength of Materials—Timoshenko and MacCullough.

34. Applied Elasticity Problems. J. Schwaighofer, K. Meipoom, S. M. Uzumeri, G. T. Will.

Course 1, III Year; 1½ hrs. laboratory per week, both terms.

Problems supplementing lecture course 33, are worked out in the laboratory. Reports written outside the laboratory period are not accepted.

35. Cements and Concrete. C. E. Helwig.

Course 1, III Year; 2 hrs. lecture per week first term, 1 hr. lecture per week second term.

A discussion of engineering cementing materials used in construction, and a study of the basic principles of concrete making.

An introduction to the theory of design of reinforced concrete elements including beams, one way slabs, columns, footing, retaining walls.

Text book: Reinforced Concrete Fundamentals—Ferguson.

36. Theory of Structures. C. F. Morrison.

Course 1a, IV Year; 2 hrs. lectures per week, both terms.

The stress analysis of simple span, continuous, and cantilever trusses. Influence lines and index stresses. Truss deflections by analytical and graphical methods. Arches, suspension bridges, and statically indeterminate structures.

Text books: Theory of Simple Structures—Shedd and Vawter. Structural Theory—Sutherland and Bowman.

37. Theory of Structures: Problems. C. F. Morrison, R. A. Collins, A. C. Davidson, D. J. L. Kennedy, S. M. Uzumeri, G. T. Will.

Course 1a, IV Year; 1½ hrs. laboratory work per week, both terms.

Problems are worked out in the laboratory following the lecture course 36. Reports written outside the laboratory period are not accepted.

38. Mechanics of Materials. General. W. L. Sagar, C. E. Helwig, C. W. Dillane, J. D. Barber, K. Meipoom.

Course 1a, IV Year; 3 hrs. laboratory per week, both terms.

The behaviour of various engineering materials under load. Verification of testing machines. The use of precision instruments in the determination of stress-strain relationships. A study of reinforced concrete beams in flexure and shear. The behaviour of some typical structural units under load. Non-destructive tests.

No laboratory report shall be written outside the assigned teaching hours.

40. Soil Mechanics and Foundations. W. L. Sagar.

Course 1a, IV Year; 2 hrs. lectures per week, both terms.

An introduction to the physical and mechanical properties of soil that govern its behaviour as an engineering material. The studies include sub-soil exploration, soil classification, moisture-density relations, shear strength, permeability, consolidation, frost action, and soil structure.

The foundation section deals with earth pressures and stress distribution in soils, bearing capacities, stability of slopes, retaining walls, cofferdams and caissons, pile and other foundations.

Reference books: Foundation Engineering—Peck, Hanson, Thornburn. Introductory Soil Mechanics and Foundations—Sowers & Sowers. Basic Soils Engineering—Hough. Proceedings, International Conferences on Soil Mechanics.

41. Reinforced Concrete. M. W. Huggins.

Course 1, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The theory of design of reinforced concrete elements including the beam, the slab, the T-beam, the column and the girderless floor, is continued in this course.

In addition the course provides an introduction to the design of prestressed concrete.

The student is required in the drafting room to apply his knowledge to the design of simple structures.

Text book: Reinforced Concrete Fundamentals—Ferguson.

Reference books: Theory & Practice of Reinforced Concrete—Dunham. Reinforced Concrete Design—Sutherland and Reese.

42. Reinforced Concrete Problems. M. W. Huggins, R. A. Collins, A. C. Davidson, D. J. L. Kennedy, S. M. Uzumeri, G. T. Will.

Course 1, IV Year; 1½ hrs. laboratory per week, both terms.

Problems supplementing lecture course 41 are worked out in the laboratory. Reports written outside the laboratory period are not accepted.

43. Structural Design. M. W. Huggins.

Course 1a, IV Year; 1 hr. lecture per week, both terms.

Consideration is given to the various types of industrial buildings and other structures, the conditions governing their choice and the design and details of construction in different materials Examples in design are worked out in the class and drafting rooms illustrating such points as: economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, wind loading, wind bracing, rigid frames, crane runways.

Reference books: Design of Steel Structures—Gaylord & Gaylord. Handbook of Building Construction—Hool and Johnson. Steel Mill Buildings—Ketchum. Structural Problems—Young and Morrison. Theory of Modern Steel Structures—Grinter.

44. Mechanics of Materials: Concrete. W. L. Sagar, C. E. Helwig, C. W. Dillane, K. Meipoom.

Course 1, III Year; 3 hrs. laboratory per week, first term.

The fundamentals in the making of concrete. The tests of Portland cement and aggregates for concrete and rock for road construction. A series of experiments to show the effect on the consistency and strength of concrete caused by variations of the ingredients. The design of mixes.

No laboratory report shall be written outside the assigned teaching hours.

Reference book: Design and Control of Concrete Mixtures—Portland Cement Assoc.

49. Soil Mechanics and Foundations. W. L. Sagar.

Course 1b, IV Year; 1 hr. lecture per week, both terms.

An abridgement of the work covered in subject 40.

50. Mechanics of Materials: Soils and Highway. W. L. Sagar, C. E. Helwig, F. A. De Lory, C. W. Dillane, J. D. Barber.

Course 1, IV Year; 3 hrs. laboratory per week, second term.

The testing of bituminous materials used in highway construction and the analysis of bituminous paving mixtures. An introduction to practical soil mechanics is provided by a series of experiments investigating the physical and mechanical characteristics of soils related to highway and foundation work.

No laboratory report shall be written outside the assigned teaching hours.

Reference books: Specifications—Department of Highways, Ontario. Specifications—A.S.T.M.; C.S.A.; A.A.S.H.O. Soil Testing for Engineers—Lambe.

51. Structural Engineering Problems. C. Hershfield, W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Course 1, III Year; 6 hrs. per week, both terms.

Problems supplementing the work covered in lecture course 28 are assigned and worked out in the drafting room.

52. Structural Enineering Problems. C. Hershfield, W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Course 3, IV Year; 3 hrs. per week, both terms.

Problems supplementing the work covered in lecture course 30 are assigned and worked out in the drafting room.

53. Structural Engineering Problems. C. Hershfield, W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Courses 2 and 4, III Year; 3 hrs. per week, second term.

Problems supplementing the work covered in lecture course 29 are assigned and worked out in the drafting room.

54. Structural Engineering Problems. C. Hershfield, W. B. Dunbar, J. Schwaighofer, L. P. Emerson, W. H. Sisson.

Course 1a, IV Year; 3 hrs. per week, both terms.

Problems supplementing the work covered in the lecture course 43 are assigned and worked out in the drafting room.

APPLIED PHYSICS

70. Applied Physics. F. B. Friend, J. R. Bird.

Course 1, II Year; 2 hrs. lectures per week, first term.

Course 7, II Year; 2 hrs. lectures per week, second term.

Correlating the physical principles of light, sound, and vibration with problems in engineering, emphasizing the importance of the analytical approach.

71. Applied Physics Laboratory. F. B. Friend, J. R. Bird.

Course 1, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, second term.

Supplementing subject 70.

Two laboratory reports per term.

72. Optics. F. B. Friend.

Courses 8 and 9, II Year; 1 hr. lecture per week, both terms.

Light, geometrical and physical optics and optical instruments, photography and photo micrography.

Reference book: A Second Course in Light—A. E. E. McKenzie.

73. Optics Laboratory. F. B. Friend, J. R. Bird.

Courses 8 and 9, II Year; 3 hrs. laboratory per week, both terms.

A laboratory course supplementing subject 72.

Two laboratory reports per term.

75. Photogrammetry. K. B. Jackson, J. Vlcek, D. J. Gerrard.

Course 1, III Year; 3 hrs. laboratory per week, first term.

A laboratory course on the instruments, materials and methods involved in the applications of photography as a means of recording, identifying and measuring the objects photographed.

77. Photogrammetry. K. B. Jackson, J. Vlcek.

Course 1b, IV Year; 1 hr. lecture per week, both terms.

Photographic optics, photographic materials and processes, photography applied to measurement. Terrestrial and aerial survey photography. Perspective, scale, tip and tilt, rectification. Planimetric mapping. Stereoscopy. Stereoscopic photographs and plotting instruments. Topographic mapping. Photo interpretation. The application of aerial photographs to mapping, to the survey of natural resources, and to planning and development.

78. Photogrammetry. K. B. Jackson, J. Vlcek, D. J. Gerrard.

Course 1b, IV Year; 3 hrs. laboratory per week, both terms.

Supplementing subject 77.

Two laboratory reports per term.

82. Acoustics. V. L. Henderson.

Course 7, IV Year; 2 hrs. lectures per week, second term.

This subject deals with the properties of acoustical elements, particularly with their application in electrical sound systems.

Reference book: Elements of Acoustical Engineering—Olson.

83. Acoustics Laboratory. L. M. Steinberg.

Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Supplementing subject 82.

Three laboratory reports.

93. Illumination. Miss M. G. Currie, J. Chisvin.

Course 7, IV Year; 2 hrs. lecture per week, second term.

Illuminating Engineering dealing with the nature, measurement, and production of light and related radiations.

Theory of human vision; the design and application of lighting equipment for visual efficiency and comfort. Fundamentals of power supply.

94. Illumination Laboratory. Miss M. G. Currie, J. Chisvin.

Course 7, IV Year; 3 hrs. per week, second term.

Supplementing subject 93.

Three laboratory reports.

97. Acoustics. V. L. Henderson.

Course 5e, III Year; 2 hrs. lectures per week, first term.

Acoustics of electrical sound systems; including sound waves hearing, the mechanical-electrical-acoustical analogy, microphones, loud speakers, etc.

Reference book: Elements of Acoustical Engineering—Olson.

98. Acoustics Laboratory. L. M. Steinberg.

Course 5e, III Year; 1½ hrs. laboratory per week, first term.

Supplementing subject 97.

99. Vibration Engineering. V. L. Henderson.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

100. Vibration Laboratory. V. L. Henderson.

Course 5t, IV Year; 3 hrs. laboratory per week, both terms.

A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurements, and control of vibration in engineering problems.

Three laboratory reports per term.

ASSAYING, MINING AND ORE DRESSING

160. Assaying. W. A. M. Hewer.

Courses 2, 8, and 9, III Year; 1 hr. lecture per week, both terms.

Theory and practice of fire assaying. Emphasis is laid not only upon the principles of chemistry, metallurgy and sampling involved, but also upon the errors inherent in operators as well as in methods.

References: Manual of Fire Assaying—Fulton and Sharwood. Textbook of Fire Assaying—Bugbee. Fire Assaying—Shepherd and Dietrich. The Sampling and Assay of the Precious Metals—E. A. Smith.

161. Assaying Laboratory. W. A. M. Hewer.

Courses 2 and 9, III Year; 3 hrs. laboratory per week, both terms.

The determination of precious metals. Scorification, crucible and combination wet and dry methods of assaying ores both simple and complex; milling and metallurgical products including cyanide solutions, cyanide precipitates and gold bullion. Attention is also given to the sampling and assay of ores containing radio-active minerals.

162. Wet Analysis. W. A. M. Hewer.

Course 2, III Year; 3 hrs. laboratory per week, both terms.

Analysis of furnace products, base metal, and radioactive ores.

164. Assaying Laboratory. W. A. M. Hewer.

Course 8, III Year; 3 hrs. laboratory per week, first term.

The instruction in general is as described under subject 161, but omitting determinations on precious-metal bullions and radioactive minerals.

165. Mining. H. R. Rice, W. A. M. Hewer.

Courses 2 and 9, II Year; 1 hr. lecture and 2 hrs. laboratory per week, second term.

A combined lecture and laboratory course in the principles of mining and its unit processes. Emphasis is placed on the statistical approach to sampling calculations.

168. Mining. H. R. Rice.

Courses 2 and 9, III Year; 3 hrs. lectures per week, first term.

Methods of mine development by mine adits, shafts, drifts and crosscuts; stoping methods, loading, and underground transportation.

169. Mining Laboratory. H. R. Rice, S. E. Wolfe.

Course 2, III Year; 3 hrs. laboratory per week, both terms.

Special mining problems are given relating to sampling, diamond drilling, stope measurements, the factors affecting the behaviour of broken materials. To develop the individual student's initiative, some special survey problems are worked in the laboratory.

170. Mine Operation and Administration. H. R. Rice.

Courses 2 and 9, IV Year; 2 hrs. lectures per week, both terms.

Lectures on advanced mining practice, including mining methods, ground control, mine mechanization, mine services and plant, aspects of administration and finance, and industrial relations.

172. Mining Laboratory. H. R. Rice.

Course 2, IV Year; 2 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A problem which progresses from essential geological data, to a complete design of the related mine, which integrates the principles of mine economics, selection of mining rates, ore-reserve calculations, and plant design.

173. Mining Laboratory. H. R. Rice.

Course 9, IV Year; 3 hrs. laboratory per week, second term.

Problems in mine layout involving shaft location and size; mine development; choice of stoping methods, mining rate, and mine equipment; time and cost schedules; ore reserve calculations.

175. Mine Ventilation and Allied Problems. G. R. Lord, F. G. Ewens.

Course 2, IV Year; 2 hrs. lectures per week, first term.

Ventilation problems in Canadian mines, including the use of ventilation equipment, selection of fans, testing equipment, ventilation studies, the silicosis problem, fire control, etc.

176. Mine Ventilation Laboratory. The staffs in Mining and Mechanical Engineering.

Course 2, IV Year; 3 hrs. laboratory per week, first term.

Experiments in the laboratories and problems in the study room to give the student some practice in the use of ventilation test

equipment, and the solution of ventilation problems. An aggregate of about ten off-campus study hours may be required in preparation of some reports.

180. Mineral Dressing. S. E. Wolfe.

Courses 2 and 8, III Year; 2 hrs. lectures per week, both terms.

The course deals with the economics of, the theoretical principles and their practical application in, the treatment of ores and mineral aggregates. These involve the processes of crushing, grinding, sizing and classification; gravity, magnetic, and electrostatic separation; and an introduction to froth flotation. In addition, ancillary processes are studied. These include flocculation, sedimentation, filtration, drying of mineral products and the precipitation and collection of dust and fume.

181. Mineral Dressing Laboratory. S. E. Wolfe.

Course 8, III Year; 6 hrs. laboratory per week, second term.

The subject matter in general is as described under Subject 182, but with more emphasis on processes involving surface phenomena.

182. Mineral Dressing Laboratory. S. E. Wolfe.

Course 2, III Year; 6 hrs. laboratory per week, second term.

This work is coordinated with the lecture course 180. Studies are made of crushing machinery, the principles of crushing and grading of rock products, screen analysis, and the sampling of broken material and mill products. Certain tests with gravity concentrating machines are made and an introduction to the technique of flotation test work is given.

183. Ore Dressing. S. E. Wolfe.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The subjects covered are extensions of those in 180, 181, and 182; cyanidation, flotation processes and techniques, the current practice at milling plants, and problems associated with milling.

184. Ore Dressing Laboratory. S. E. Wolfe.

Course 2, IV Year; 6 continuous hours per week, first term.

Advanced work coordinated with lecture course 183 and pertaining to ore dressing appliances, the handling in bulk of finely divided solids, the selective flotation of sulphides, ore testing, and pilot plant mill runs.

186. Mineral Dressing. S. E. Wolfe.

Course 9, III Year; 2 hrs. lectures per week, first term.

This abridged course deals with current practice and fundamental principles in the field of mineral beneficiation.

192. Summer Essay. W. A. M. Hewer.

Course 2, III Year:

An essay, or report, written on a mining subject, preferably some phase of work with which the student is associated during

summer employment. Subsequently, each student will deliver a talk to his class on the subject chosen. Thus, training is afforded in both technical writing and public speaking. Students are briefed in advance concerning requirements of this course.

193. Oral Expression. Mrs. Helen Tucker.

Courses 2 and 9, II Year; 2 hrs. seminar per week, second term.

A seminar course in oral expression. The objective is to improve the ability to speak as a means of communication. Clear expression of sound thinking is discussed and practised in speech assignments.

ASTRONOMY AND GEODESY

No laboratory reports shall be written outside the assigned teaching hours.

200. Practical Astronomy. H. L. Macklin.

Course 1, II Year; 1 hr. lecture per week, both terms.

The derivation of formulae and their application to the solution of spherical triangles and practical problems. Practical determination of time, latitude and azimuth by methods adapted to the use of the surveyor's transit. The subject will be designed to enable the student to carry out these observations at the Summer Survey Camp.

Text books: Practical Astronomy—Nassau.

201. Control Surveys. O. J. Marshall.

Course 1, III Year; 1 hr. lecture per week, second term.

Principles and Methods of control surveys involving triangulation, traverse, and levelling of various degrees of precision; elementary geodesy and map projections.

Reference books: Higher Surveying—Breed and Hosmer, Vol. II, 8th Ed. Theory and Practice of Surveying—Tracy. Advanced Surveying and Mapping—Whitmore.

202. Astronomy. H. L. Macklin.

Course 1_b, IV Year; 1 hr. lecture per week, first term.

Precise determination of time, latitude, longitude and azimuth as applied to geodetic surveys.

203. Astronomy. H. L. Macklin.

Course 1_b, IV Year; 3 hrs. laboratory per week, first term.

Observations and problems to accompany subject 202.

204. Geodesy. O. J. Marshall.

Course 1_b, IV Year; 2 hrs. lectures per week, second term.

Geometry of the spheroid, geographic co-ordinates, common map projections with related co-ordinate systems.

205. Geodesy. O. J. Marshall.

Course 1_b, IV Year; 3 hrs. laboratory per week, second term Problems in geodetic computations.

CIVIL ENGINEERING

214. Sanitary Engineering. A. P. Bernhart.

Course 1, IV Year; 2 hrs. lectures per week, both terms.

Impact of towns and industries on cycle of water, protection of water resources. selfpurification.

Supply, purification and distribution of water. Collection and treatment of domestic and industrial waste water.

Control of air pollution.

215. Sanitary Engineering Laboratory. A. P. Bernhart.

Course 1, IV Year; 1½ hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.

First term: Six inspection field trips to Water Purification and Sewage Treatment plants in the Toronto area.

Six reports.

Second term: Design problems supplementing the work covered in Subject 214.

216. Municipal Planning, Administration and Transportation. H. L. Macklin, M. Hugo-Brunt, M. M. Davis.

Course 1, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Contemporary concepts in town and regional planning and their theoretical, practical and legal applications as applied in Canada.

Organization of municipal government, municipal finance, legislation governing municipal operation, role of the municipal engineer and private practitioner in public works, provisions of municipal services.

Urban and regional growth as affected by transportation, trends, demands, characteristics and capacities, co-ordination with land use and integration with other services.

217. Highway Engineering. M. M. Davis.

Course 1, IV Year; 1 hr. lecture per week, both terms.

Organization, administration, economics and planning of rural highways; highway materials and paving; principles of location, design, construction and maintenance.

Text book: Highway Engineering—Hewes and Oglesby.

Reference books: The Highway Improvement Act—Ontario Highway Standards and Specifications—Department of Highways of Ontario. Soil Mechanics for Road Engineers—D.S.I.R.—H. M. Printer. Policy on Geometric Design of Rural Highways—A.A.S.H.O.

218. Construction Management and Business. M. G. Tallon, F. N. Beard.

Course 1, IV Year; 2 hrs. lectures per week, second term.

A study of heavy and building construction, including job planning and organization, construction methods and equipment, superintendence, job records, labour relations and safety procedures. Elements of business organization and management with an introduction to the principles of control through accounting records and financial statements.

219. Town and Regional Planning. M. Hugo-Brunt.

Course 1b, IV Year; 1 hr. lecture per week, first term.

Town Planning principles both past and present. The role of the planner, the plan, local legislation, the central area, the neighbourhood, subdivision, the suburb, open space and the region, housing, road layout, services, industry, commerce and special uses.

220. Town and Regional Planning. M. Hugo-Brunt.

Course 1b, IV Year; 3 hrs. practical work per week, first term.

Studio work including exercises in survey, research and analysis, subdivision layout, and urban analysis. These are related to subject 219.

CHEMISTRY AND CHEMICAL ENGINEERING

221. Chemistry. The Staff in Chemical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

Chemical theory, with industrial and engineering applications.

222. Chemical Laboratory. W. F. Graydon, J. Binkiewicz.

Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, I Year; 3 hrs. laboratory per week, both terms.

A laboratory course illustrating the fundamental laws of chemistry as dealt with in the lecture course, and providing an introduction to chemical analytical methods.

223. Chemistry. W. H. Burgess.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Introductory physical chemistry: the gas laws, chemical equilibria, elementary solution chemistry, thermochemistry. Problems dealing with industrial and engineering applications.

224. Chemistry. W. F. Graydon, O. W. Berg.

Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.

Calculations based on systems in equilibrium; examples from pH solubility, complex formation and phase equilibrium.

225. Chemistry. A. D. Allen.

Course 7, II Year; 2 hrs. lectures per week, first term.

Inorganic Chemistry, with emphasis on the fundamental particles, atomic structure, the nature of the chemical bond and the general chemistry of the metallic elements.

226. Engineering Chemistry. Staff in Chemical Engineering.

Courses 1, 3, and 4, II Year; 2 hrs. lectures per week, first term.

Corrosion and water-treatment; introduction to organic chemistry.

227. Analytical Chemistry Laboratory. W. F. Graydon, O. W. Berg.

Courses 2 and 9, II Year; 6 hrs. laboratory per week, first term.

Volumetric and gravimetric analysis.

228. Analytical Chemistry Laboratory. F. E. Beamish.

Course 8, II Year; 4 hrs. laboratory per week, both terms.

Quantitative and qualitatve analysis.

229. Analytical Chemistry Laboratory. I. H. Spinner, C. P. Brockett.

Course 6, II Year.

This course commences on the Wednesday following the first Monday in September, and continues until the opening of the Fall Term. All the working time will be spent on systematic quantitative inorganic analysis.

Text book: Textbook of Inorganic Analysis—Kolthoff and Sandell.

230. Industrial Chemistry. W. G. MacElhinney.

Course 6, II Year; 2 hrs. lectures per week, first term: 1 hr. lecture per week, second term.

Manufacture of acids, alkalis, and inorganic chemicals; water-treatment, corrosion, explosives.

231. Inorganic Chemistry. R. E. Jervis.

Courses 6 and 8, II Year; 1 hr. lecture per week, first term: 2 hrs. lectures per week, second term.

The constitution of matter and classification of the elements: systematic inorganic chemistry.

232. Analytical Chemistry. I. H. Spinner.

Course 6, II Year; 2 hrs. lectures per week, first term.

Equilibrium considerations in quantitative analysis.

233. Analytical Chemistry Laboratory. I. H. Spinner, C. P. Brockett.

Course 6, II Year; 9 hrs. laboratory per week, first term.

A continuation of Subject 229.

234. Organic Chemistry. J. G. Breckenridge.

Course 6, II Year; 1 hr. lecture per week, first term: 2 hrs. lectures per week, second term.

An introductory course in organic chemistry, with emphasis on reaction conditions and yields, and the industrial significance of certain compounds and reactions.

Text book: Systematic Organic Chemistry—Muldoon and Blake.

235. Chemical Engineering Science Laboratory. I. H. Spinner, C. P. Brockett.

Course 6, II Year; 12 hrs. laboratory per week, second term.

Experiments illustrating the kinetic and equilibrium principles of chemical engineering. Instruction is given in shop practice, glass-blowing, and mass and heat balance calculations.

One laboratory report per week.

236. Physical Chemistry. R. L. McIntosh.

Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.

Principles of Phase Rule; introduction to chemical thermodynamics and theory of solutions.

Text book: Principles of Phase Equilibria—Wetmore and LeRoy.

237. Inorganic Chemistry. A. D. Allen.

Course 5, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

General inorganic chemistry, stereochemistry, and related physical measurements.

238. Physical Chemistry. R. W. Missen.

Course 5, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

A continuation of subject 223, including: chemical kinetics and diffusion, surface chemistry and catalysis.

Text book: Physical Chemistry—MacDougall.

Reference book: Chemical Engineering Kinetics—Smith.

239. Chemical Theory A. W. H. Burgess, W. F. Graydon, R. R. McLaughlin.

Course 6, III Year; 1 hr. lecture per week, both terms.

Chemical kinetics; principles of adsorption and colloid chemistry.

240. Chemical Theory B. W. H. Burgess, W. F. Graydon.

Courses 5c and 6, III Year; 2 hrs. lectures per week, both terms.

Chemical thermodynamics, introductory to subject 256.

241. Industrial Chemistry. W. G. MacElhinney, W. H. Rapson.

Course 6, III Year; 3 hrs. lectures per week, second term.

Chemical process industries, including petroleum, soap, sugar, pulp and paper, and fermentation industries. In preparation for this course, students will be expected to have read and to be thoroughly familiar with the following: Chemical Process Industries—Shreve: Chapters 29, 30, 31, 33, 34, 37.

242. Introduction to Mass and Heat Transfer. W. G. MacElhinney.

Course 6, III Year; 2 hrs. lectures per week, both terms; 3 hrs. laboratory per week, second term.

The fundamental theory and practice used in transfer operations in chemical engineering. Energy and mass transfer are considered in the study of the flow of fluids, fluidization of solids, heat transfer, and evaporation of solutions.

Text book: Unit Operations of Chemical Engineering—McCabe and Smith.

244. Organic Chemistry. J. G. Breckenridge.

Course 6, III Year; 2 hrs. lectures per week, both terms.

A continuation of subject 234, dealing mainly with aromatic compounds.

245. Organic Chemistry Laboratory. W. H. Rapson, Z. May.

Course 6, III Year; 9 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A laboratory course accompanying subject 244.

One laboratory report per week.

246. Electrochemistry. F. E. W. Wetmore.

Course 8, III Year; Course 6, IV Year; 2 hrs. lectures per week, first term.

Elementary electrochemistry.

247. Electrochemistry Laboratory. C. Steel.

Course 8, III Year; Course 6, IV Year; 18 hrs., first term.

Quantitative measurements to accompany subject 246.

249. Chemical Laboratory. W. F. Graydon, Z. May.

Courses 5c and 6, III Year; 6 hrs. laboratory per week, both terms.

A laboratory course to accompany subject 240.

250. Organic Chemistry. J. G. Breckenridge, I. H. Spinner.

Course 5c, IV Year; 2 hrs. lectures per week, both terms.

A lecture course in organic chemistry, concluding with a section on the chemistry of high polymers.

251. Chemical Engineering Laboratory. A. I. Johnson, W. G. MacElhinney, R. W. Missen, D. Trass.

Course 6, IV Year; 10 hrs. laboratory per week, first term.

A laboratory course to accompany subjects 242, 253, and 254. Bench and pilot plant experiments are carried out to study a variety of unit operations such as fluidization, heat transfer, evaporation, filtration, distillation, extraction, and absorption. Modern control instruments are discussed and operated. Experimental work for subject 254 is undertaken as a part of this laboratory.

One laboratory report per week.

252. Chemical Engineering Laboratory. Staff in Chemical Engineering.

Course 5c, IV Year; 6 hrs. laboratory per week, first term; 9 hrs. per week, second term.

Experiments illustrating the principles encountered in subjects 256 and 261.

253. Mass Transfer Operations. A. I. Johnson.

Course 6, IV Year; 2 hrs. lectures per week, both terms.

The theory and practice of mass transfer operations in chemical engineering are discussed. Many problems in distillation, extraction, absorption, and other operations illustrate the course.

Text book: Mass Transfer Operations—R. E. Treybal.

254. Chemical Plant Design. Staff in Chemical Engineering.

Course 6, IV Year; 1 hr. lecture per week, first term: 3 hrs. laboratory per week, second term.

Process design data for a typical chemical synthesis are collected from pilot plant studies. A full scale unit is then designed to illustrate the practical use of heat and mass transfer, fluid-flow, and thermodynamic and kinetic principles studied in other courses. Due consideration is given to economic considerations in this work.

255. Applied Mathematics in Chemical Engineering. A. I. Johnson, R. W. Missen.

Course 6, IV Year; 3 hrs. laboratory per week, first term.

A laboratory subject to accompany subjects 242, 253, and 254. Selected chemical engineering problems, introducing the students to graphical methods, alignment charts, numerical methods, and the application of differential equations, are discussed.

Text book: Applied Mathematics in Chemical Engineering—Sherwood and Reed.

256. Chemical Engineering Thermodynamics and Kinetics. W. H. Burgess, W. F. Graydon.

Courses 5c and 6, IV Year; 2 hrs. lectures per week, both terms.

The application of thermodynamics and kinetics to problems in the field of chemical engineering.

257. Organic Chemistry. R. R. McLaughlin.

Course 6, IV Year; 1 hr. lecture per week, both terms.

The chemistry of natural and synthetic high-molecular-weight materials.

258. Organic Chemistry Laboratory. J. G. Breckenridge.

Course 5c, IV Year; 3 hrs. laboratory per week, first term.

A laboratory course to accompany subject 250.

261. Diffusion and Mass Transfer. A. I. Johnson.

Course 5c, IV Year; 2 hrs. lectures per week, both terms.

Fundamental concepts of molecular diffusion, and application to transfer through still fluids and fluids in streamline flow. Mass transfer resulting from turbulent flow. Consideration of the resistance to mass transfer at phase interfaces. Consideration of the principles underlying the analysis and operation of mass transfer equipment for gas-liquid, liquid-liquid, and solid-liquid operations.

Text book: Mass Transfer Operations—Treybal.

Reference books: Mathematics of Diffusion—Crank; Advances in Chemical Engineering, Vol. 1—Drew & Hoopes.

DESCRIPTIVE GEOMETRY, ENGINEERING PROBLEMS AND DRAWING

DESCRIPTIVE GEOMETRY

269. Descriptive Geometry. C. A. Wrenshall, H. R. Frizzle.

All courses, I Year; 1 hr. lecture per week, both terms.

These lectures deal with the principles of orthographic and oblique projection and their use in solving problems of straight lines, planes, and curved surfaces.

Text book: Descriptive Geometry—Watts and Rule.

272. Descriptive Geometry. C. A. Wrenshall.

Course 1, II Year; 2 hrs. lectures per week, first term.

A continuation of lecture course 269. Problems of curved surfaces, shades, shadows and perspective are discussed: also, an introduction is given to the principles of projection used in map making.

Text book: Descriptive Geometry—Watts and Rule.

ENGINEERING PROBLEMS AND DRAWING

The courses in Engineering Problems and Drawing consist primarily in the solving of problems by the student at the drafting table under the personal guidance of an instructor. The problems deal with the fundamental engineering studies—mathematics, applied mechanics, descriptive geometry, the plotting of surveys that have been made by the student in the field, theory of machines.

275. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle, A. W. Walker.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 9 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (analytical geometry and calculus.) Plotting of original surveys for courses 1, 2 and 9.

Text book: Engineering Drawing—French and Vierck, latest Edition.

276. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle.

Course 5, I Year; 6 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (algebra and geometry, and calculus).

Text book: Engineering Drawing—French and Vierck, latest Edition.

284. Engineering Problems and Drawing. C. A. Wrenshall, A. W. Walker.

Course 1, II Year; 10½ hrs. per week, first term; 6 hrs. per week, second term.

Problems in descriptive geometry—intersection of curved surfaces. Plotting of original surveys. Problems in mechanics of materials. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition.

286. Engineering Problems and Drawing. B. M. M. Carpendale, C. L. Proctor.

Course 3, II Year; 6 hrs. per week, both terms.

Problems in descriptive geometry—intersection of curved surfaces. Problems in mechanics of materials, theory of machines. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition. Elements of Calculus—Peterson.

287. Engineering Problems and Drawing. A. W. Walker.

Courses 2, 6 and 9, II Year; 3 hrs. per week, alternate weeks, both terms.

Problems in mathematics.

288. Engineering Problems and Drawing. B. M. M. Carpendale, C. L. Proctor.

Course 4, II Year; 6 hrs. per week, both terms.

Problems in descriptive geometry—intersection of curved surfaces. Problems in mechanics of materials. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition. Elements of Calculus—Peterson.

289. Engineering Problems and Drawing. C. A. Wrenshall, A. W. Walker.

Course 8, II Year; 3 hrs. per week, both terms.

Problems in descriptive geometry, mechanics of materials and mathematics.

Text book: Engineering Drawing—French-Vierck, 8th Edition.

BUSINESS ADMINISTRATION, ECONOMICS, HISTORY AND LAW

306. Accounting. F. N. Beard.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Basic accounting principles and procedures, the preparation and interpretation of financial statements, cost accounting, and the use of accounting as a means of control.

310. Business. F. N. Beard.

Courses 2, 3, 7 and 9, III Year; 1 hr. lecture per week, second term.

Elements of business organization and management with an introduction to the principles of control through accounting records and financial statements.

311. Economics. D. F. Forster, J. H. Griggs, T. M. Russell, M. H. Watkins.

All courses, II Year; 2 hrs. lectures per week, both terms.

An Introduction to the study of Economics with special reference to the problems of the Canadian economy.

314. Engineering Law. W. O. Chris. Miller.

Courses 1, 3, 4, 6, and 7, IV Year; 1 hr. lecture per week, first term.

A subject designed to co-ordinate the practice of engineering and law. Consideration is given to the characteristics, advantages and disadvantages of companies, partnerships and sole proprietorships, the promotion, organization and financing of companies, the duties of employees to employers, the duties and liabilities of engineers, statutes applicable to engineering works, professional engineering associations, construction contracts, workmen's compensation, trade unions and industrial disputes.

Text book: Engineering Law—Laidlaw and Young.

315. Industrial Management. B. M. M. Carpendale, D. J. Clough, P. B. Hughes.

Courses 3, 6, 7, IV Year; 1 hr. lecture per week, first term.

Introduction to principles of management, control methods, work measurement, wages and incentive.

Subjects 314 and 315 are combined in one examination.

319. Public Speaking. The Staff in Chemical Engineering.

Course 6, III Year; 1 hr. per week, both terms.

320. Industrial Management. T. C. Graham.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

A study of the factors involved in the production and distribution of products or services. Consideration will be given to the general concepts of management, organization, leadership and industrial relations but major emphasis will be on work simplification, time and motion study, wage administration and controls of production, quality and costs.

322. Industrial Management Laboratory. T. C. Graham.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Cases and problems to accompany the lecture subject.

323. Introduction to Political Science. W. E. Grasham, J. T. McLeod.

All courses, I Year; 1 hr. lecture per week, both terms.

An introduction to the study of government with special reference to the problems of Canadian government.

324. Europe and the Modern World, 1500–1950. J. C. Cairns, E. M. Beame.

All courses, III Year; 2 hrs. lectures per week, both terms.

An introduction to the main currents of European history between 1500 and 1950, and of European relations with the extra-European world. The purpose of the course is not the accumulation of factual information but the attainment of some understanding of historical processes, affecting the forms of political organization, economic activity, intellectual and social movements.

326. Philosophy of Science. Marcus Long, C. W. Webb.

Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, IV Year; 2 hrs. lectures per week, first term.

The relation between Science and Philosophy; an examination of the presuppositions of science and its basic concepts; alternative accounts of the nature of the universe with their implications for social and moral behaviour.

327. Industrial Psychology. W. Line.

Course 4, III Year; 2 hrs. lectures per week, second term.

A series of lectures and discussions on human relations, with the focus on some of the current problems in a developing industrial culture.

ELECTRICAL ENGINEERING

330. Electricity. Staff in Electrical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism, including Kirchhoff's Laws and network theorems as applied to direct-current circuits, induced voltages, self and mutual inductance and an introduction to electric field concepts. The MKS system of units is used.

Text book: Introduction to Electrical Engineering—Ward.

331. Electricity. Staff in Electrical Engineering.

Course 5, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism that is similar to subject 330 but adapted to the needs of Course 5.

332. Electric Circuits I. A. J. Kravetz.

Course 7, II Year; 3 hrs. lectures per week both terms; 2 hrs. computation, alternate weeks, both terms.

The relation of lumped parameters to field concepts, their physical realization and their variation with frequency. The representation of simple systems by lumped parameter circuits.

The analysis of linear circuits in the steady state with either direct or alternating sources. Loop and nodal methods. The elements of the topography of circuits. Coupled circuits. Response of circuits to variable frequency.

The transient response of simple linear circuits to suddenly applied sources and its relation to the steady state.

Three-phase circuits, balanced and unbalanced. Other polyphase circuits.

General network theorems, rigorously derived, including the transformation theorems.

333. Electric and Magnetic Fields. G. R. Slemon.

Course 7, II Year; 2 hrs. lectures per week, both terms; 2 hrs. computation, alternate weeks, both terms.

Electric and magnetic fields, forces and energies associated with charged and current-carrying conductors embedded in dielectric and magnetic media. Particle dynamics in electric and magnetic fields. Time-varying fields in conductors and insulators. Development of Maxwell's equations and interpretation in static and dynamic situations.

334. Electrical Laboratory.

Courses 3 and 4, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, both terms.

Appropriate laboratory experiments to accompany subjects 332, 338, and 340.

Courses 3 and 4. Six laboratory reports.

Course 7. Ten laboratory reports.

335. Electrical Problems and Seminar.

Course 7, III Year; 4 hrs. per week, both terms.

Problems associated with courses 337, 339 and 341 are worked out under staff supervision. To provide practice in public speaking, one hour per week in the second term is devoted to short talks and discussions by the students on topics of their own choice.

336. Mathematics.

Course 7, III Year; 2 hrs. lectures per week, both terms; 2 hrs. computation per week, both terms.

Numerical analysis; functions of a complex variable, with applications; elements of probability and statistics, with applications.

337. Electronics. J. L. Yen.

Course 7, III Year; 2 hrs. lectures per week, first term; 3 hrs. lectures per week second term.

The behaviour of charged particles in electromagnetic fields. Electrical conduction in solids and gases. Electron emission. Semiconductor and vacuum devices. Electronic circuits.

338. Electricity. H. A. Courtice.

Courses 3 and 4, II Year; 2 hrs. lectures per week, first term.

General principles and calculations of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power, and energy. The principles underlying commercial instruments are considered, together with the methods of calibration.

Reference books: Electrical Measurements—Laws. Basic Electrical Measurements—Stout.

339. Electric Machinery I. G. R. Slemon.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Processes for the electro-mechanical conversion of energy. The fields, forces and torques in singly and multiply-excited magnetic systems. Theory, characteristics and applications of direct-current machines. Introduction to the dynamic behaviour and control of machines. Theory and applications of transformers. Introduction to rotating magnetic fields.

Reference books: Electric Machinery—Fitzgerald and Kingsley. Principles of Direct-Current Machines—Langsdorf. Direct-Current Machinery—Kloeffler, Brenneman, and Kerchner.

340. Electrical Measurements. H. A. Courtice.

Course 7, II Year; 2 hrs. lectures per week, second term.

Measurement of electrical quantities such as charge, potential difference, current, magnetic flux, energy and power. Measurement of electrical properties such as dielectric constant, permeability and conductivity. Measurement of resistance inductance and capacitance. Transducers for electrical measurement of mechanical, thermal and other physical quantities. Measurement of alternating-current quantities in single phase and polyphase systems. Accuracy of measurement, curve fitting and treatment of measured data.

341. Electric Circuits II. V. G. Smith.

Course 7, III Year; 3 hrs. lectures per week, both terms.

Loop and nodal equations and methods of solution. Matrix notation. General theorems. Input and transfer admittances and impedances and dimensionless transfer functions. Symmetrical component analysis. Fourier series and integrals. Fourier and Laplace transforms, direct and inverse. Operational methods applied to transients in linear systems. Dependent sources. Two-port networks. Electrical filters.

342. Electric Machines. W. Janischewskyj.

Course 4, IV Year; 2 hrs. lectures per week, first term.

Operating characteristics and applications of transformers and rotating electric machines.

343. Electric Machines Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, first term.

Laboratory exercises to accompany subject 342.

Four laboratory reports.

344. Electrical Laboratory.

Course 7, III Year; 3 hrs. laboratory per week, both terms.

This laboratory course accompanies lecture courses 339 and 341. It consists of three groups of experiments dealing respectively with direct current machinery, fundamental properties of single-phase and three-phase alternating-current circuits and the single-phase transformer.

Eight laboratory reports.

345. Electronics. I. R. Dalton, P. E. Burke.

Courses 3 and 4, III Year; 2 hrs. lectures per week, first term.

Thermionic emission, vacuum-tube characteristics and applications, gaseous-tube characteristics and applications, control systems.

Text book: Introduction to Industrial Electronics—Benedict.

346. Electronics Laboratory.

Courses 3 and 4, III Year; 3 hrs. laboratory alternate weeks, first term.

Laboratory exercise to accompany subject 345.

Four laboratory reports.

347. Electric Circuits and Machines. A. Straughen.

Courses 1 and 2, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Principles of single-phase and three-phase alternating currents. Basic a.c. measurements. Principles of operation of d.c. and a.c. machines. Introduction to electronics.

Text book: Basic Electrical Engineering—Fitzgerald and Higginbotham.

348. Electrical Laboratory.

Courses 1 and 2, II Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory experiments to accompany subject 347.

Three laboratory reports.

350. Circuit Analysis. V. G. Smith.

Course 5e, IV Year; 2 hrs. lectures per week, both terms.

Advanced analytical methods are used to derive general network theorems and to discuss general network properties. Complex wave forms, filters and unbalanced polyphase networks are considered in detail.

Reference books: Alternating-Current Circuits—Kerchner and Corcoran. Alternating-Current Bridge Methods—Hague. Symmetrical Components—Wagner and Evans.

351. Circuit Analysis. V. G. Smith.

Course 7, IV Year; 2 hrs. lectures per week, first term; 3 hrs. lectures per week, second term.

Advanced analytical methods are used to derive general network theorems and to discuss general network properties. Electric wave filters and unbalanced power networks receive detailed consideration.

Reference books: Same as for subject 350.

352. Transmission at Low and High Frequencies. G. Sinclair.

Course 7, IV Year; 3 hrs. lectures per week, first term.

The propagation of waves on transmission lines, under transient and steady-state conditions.

353. Alternating Current Machinery I. G. F. Tracy.

Course 7, IV Year; 3 hrs. lectures per week, first term.

The theory and performance of generators, synchronous motors, single and polyphase induction motors.

Reference books: Principles of Alternating Current Machinery—Lawrence. Alternating Current Machines—Puchstein and Lloyd. Electrical Machinery—Fitzgerald and Kingsley.

354. Electric Circuits. G. R. Slemon, P. E. Burke.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Circuits as models for physical devices. Kirchhoff's laws and network topology. Network theorems. Complex algebra in alternating-current circuit analysis. Applications to single and polyphase power circuits, instruments, transformers, electronic circuits.

355. Electrical Laboratory.

Course 7, IV Year; 3 hrs. laboratory per week, first term; 1½ hrs. laboratory per week, second term.

Studies of principles and properties of single-phase and polyphase circuits and apparatus. Vector and analytical methods are applied to the solution of problems related to the characteristics of transformers, alternators, synchronous motors, converters, induction motors, transmission lines, and other alternating current equipment.

Seven laboratory reports.

Reference books: Electrical Engineering—Christie. Experimental Electrical Engineering, Vols. I and II—Karapetoff. Principles of A.C. Machinery—Lawrence. A.C. Machinery—Bryant and Johnson. Principles of Alternating Current Machinery—Langsdorf.

356. Electric Circuits Laboratory.

Course 5, II Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory exercises to accompany subject 354.

Ten laboratory reports.

357. Electrical Control Systems. J. M. Ham, R. J. Kavanagh, I. McCausland.

Courses 5e, 5n, and 7, IV Year; 2 hrs. lectures per week, both terms.

A study of the analysis and synthesis of linear feedback control systems by means of differential equations and the Laplace transformation. Topics covered include methods of compensation, stability, root-locus methods, systems with time delays, and a.c. control systems. An introductory study of non-linear systems is also made, including the use of describing function and phase-plane methods of analysis.

358. Electric Control Systems Laboratory.

Courses 5e, 5n and 7, IV Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory experiments and design problem periods to accompany subject 357.

Four laboratory reports.

359. Electrical Problems and Seminar.

Course 7, IV Year; 2 hrs. per week, both terms.

Oral presentation by each fourth year student of his thesis, together with discussions by other members of the group.

360. Communications I. J. E. Reid.

Courses 5e, 5s, 5m and 7, IV Year; 3 hrs. lectures per week, first term.

The basic principles of amplification, detection, modulation, demodulation, and radio-frequency power generation.

Reference book: Applied Electronics—Gray.

361. Communications Laboratory.

Courses 5e, 5s, 5m and 7, IV Year; 3 hrs. laboratory per week, first term.

Experiments and problems to accompany subject 360.

Six laboratory reports.

362. Communications II. J. E. Reid.

Courses 5e and 7, IV Year; 3 hrs. lectures per week, second term.

A continuation of subject 360 covering theory and design of Class B and C amplifiers, power oscillators, crystal oscillators. Noise in communication circuits. Frequency conversion. Impedance transformation.

Reference book: Applied Electronics—Gray.

363. Communications Laboratory.

Courses 5e and 7, IV Year; 3 hrs. laboratory per week, second term.

Experiments and problems to accompany subjects 362 and 371.

Seven laboratory reports.

364. Operational Methods. V. G. Smith.

Courses 5e, 5m, 5n, 5s and 5t, IV Year; 2 hrs. lectures per week, both terms.

Classical and Heaviside's operational methods are developed. Fourier's methods leading to the Laplace transforms are discussed and the close relationship between Laplace and Heaviside emphasized. Applications are chiefly to electric circuit analysis.

Reference books: Transformation Calculus and Electric Transients—Goldman. Electromagnetic Theory—Heaviside. Transients in Linear Systems—Gardner and Barnes. Simple Calculation of Electrical Transients—Carter.

365. Applied Electromagnetic Theory. G. Sinclair.

Courses 5e, 5g, 5m, 5n and 5s, IV Year; 2 hrs. lectures per week, both terms.

Electrostatics is reviewed and developed further to compute the capacities of engineering structures. Electromagnetism is reviewed and Maxwell's equations obtained. These are then applied in a study of plane waves, wave guides and antenna radiation.

Reference book: Electromagnetic Waves and Radiating Systems —Jordan.

366. Electronics, J. L. Yen.

Course 5, III Year; 2 hrs. lectures per week, both terms.

Basic theory of the behaviour of electrons in electric and magnetic fields, thermionic emission, transistor and electron-tube characteristics, circuit models and applications, conduction through gases.

Reference book: Applied Electronics—T. S. Gray.

367. Alternating-Current Circuits. I. R. Dalton, P. E. Burke.

Courses 3 and 4, II Year; 2 hrs. lectures per week, second term.

Fundamentals of alternating current, voltage and power. The analysis of series, parallel and three-phase circuits containing resistance, inductance and capacitance.

368. Alternating-Current Circuit Laboratory.

Courses 3 and 4, II Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 367.

Three laboratory reports.

369. Alternating Current Machinery II. G. F. Tracy.

Course 7, IV Year; 2 hrs. lectures per week, second term.

A continuation of subject 353. Special types of alternating current motors, synchronous converters, single-phase induction motors, frequency changes, selsyn devices.

370. Alternating Current Machinery Laboratory.

Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 369.

Three laboratory reports.

371. Communications III. G. Sinclair.

Courses 5e and 7, IV Year; 2 hrs. lectures per week, second term.

Transmission lines at ultra-high frequencies, generation and amplification at high frequencies, semi-conductor devices at low frequencies.

373. Electric Power Systems. G. R. Slemon.

Course 7, IV Year; 2 hrs. lectures and 2 hrs. computation per week, second term.

The theory associated with the economic generation, transmission and distribution of electrical energy in bulk and the control of power systems under normal and fault conditions.

375. Electrical Engineering. A. Straughen.

Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.

Basic d.c. measurements. Principles of single-phase and three-phase alternating currents. Elementary transients. Basic a.c. measurements. Principles of operation of d.c. and a.c. machines. Introduction to electronics.

Text book: Basic Electrical Engineering—Fitzgerald and Higginbotham.

376. Electrical Engineering Laboratory.

Courses 6 and 8, II Year; 3 hrs. laboratory per week, both terms.

Laboratory experiments to accompany subject 375.

Ten laboratory reports.

377. Electric Machines. A. J. Kravetz.

Courses 3 and 5e, III Year; 2 hrs. lectures per week, both terms.

Operating characteristics, control, and applications of direct-current and alternating-current machines.

378. Electric Machines Laboratory.

Courses 3 and 5e, III Year; 3 hrs. laboratory alternate weeks, first term; 3 hrs. laboratory per week, second term.

Laboratory exercises to accompany subject 377.

Seven laboratory reports.

379. Electronics Laboratory.

Courses 5 and 7, III Year; 3 hrs. laboratory per week, second term.

Laboratory experiments to accompany subjects 337 and 366.

Five laboratory reports.

GEOLOGICAL SCIENCES

380. Physical Geology. P. A. Peach.

Courses 2 and 9, II Year; 2 hrs. lectures per week, first term. Course 5g, III Year; see subject 413.

An introduction to the study of geology and mineralogy.

Reference books: Principles of Geology—Gilluly, Waters and Woodford *or* Physical Geology—Leet and Judson.

381. Physical Geology Laboratory.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. laboratory and 1 hr. tutorial per week, first term.

A laboratory course to accompany subject 380.

382. Engineering Geology. W. H. Gross.

Course 1, III Year; 2 hrs. lectures per week, both terms.

An introduction course in geology with special reference to engineering problems.

383. Engineering Geology Laboratory.

Course 1, III Year; 2 hrs. per week, both terms.

Specimens, maps, and sections to accompany subject 382.

384. Glacial Geology and Ground Water. R. E. Deane.

Courses 2 and 5g, IV Year; 1 hr. lecture per week, both terms.

Pleistocene Geology. The formation and distribution of the drift deposits of North America, with emphasis on their economic importance.

385. Elementary Geochemistry. F. G. Smith.

Course 9, III Year; 2 hrs. lecture per week, both terms.

Covering the periodic table, distribution of the elements, states of matter, phase diagrams, natural hydrothermal solutions, weathering, and geochemical cycles.

386. Mineralogy and Lithology. D. H. Gorman, P. A. Peach.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. lecture per week, both terms.

A study of crystallography, descriptive and determinative mineralogy, and the common rocks.

Reference book: An Introduction to the Study of Minerals—Rogers.

387. Mineralogy and Lithology Laboratory. D. H. Gorman, P. A. Peach.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. per week, both terms.

Practice in identifying minerals and rocks.

388. Descriptive Mineralogy. D. H. Gorman.

Course 9, III Year; 2 hrs. laboratory per week, both terms.

Continuation of the mineralogy of subject 386.

389. Ore Microscopy. D. H. Gorman.
Course 9, III Year; 3 hrs. laboratory per week, second term.
Identification of minerals in polished sections.

390. Crystallography. E. W. Nuffield.
Courses 5c, 5m, 5s and 8, III Year; 1 hr. lecture per week, both terms.
The modern concept of crystals; symmetry elements; derivation of space lattices, classes, forms, indices.

391. Petrology. P. A. Peach.
Course 9, III Year; 3 hrs. lecture per week, first term; 2 hrs. lecture per week, second term.
Microscopic character of the rock-forming minerals in thin sections, and description and classification of rocks.

392. Petrography Laboratory. P. A. Peach.
Course 9, III Year; 2 hrs. per week, both terms.
Microscopic petrography, to accompany subject 391.
Text book: Optical Mineralogy—Rogers and Kerr.

393. Historical and Stratigraphical Geology. F. W. Beales.
Courses 2 and 9, II Year; 2 hrs. lectures and 1 hr. tutorial per week, second term.
Study of the principles of stratigraphy and historical geology since Precambrian times.

394. Historical and Stratigraphical Geology Laboratory. F. W. Beales.
Course 9, II Year; 2 hrs. per week, second term.
Laboratory work to illustrate subject 393.

395. Palaeontology. M. A. Fritz.
Course 9, III Year; 2 hrs. lecture per week, both terms.

396. Palaeontology Laboratory. M. A. Fritz.
Course 9, III Year; 2 hrs. per week, both terms.

397. Structural Geology. J. B. Currie.
Courses 2, 5g and 9, III Year; 1 hr. lecture per week, both terms.
Structures caused by the deformation of the earth's crust.
Text book: Structural Geology—Billings.

398. Structural Geology Laboratory. J. B. Currie.
Courses 2, 5g and 9, III Year; 3 hrs. per week, both terms.
Work with geological maps of folded and faulted areas, structural sections, and the solution of problems relating to folding and faulting.
Laboratory course to accompany subject 397.

399. Mineral Deposits. W. H. Gross.
Courses 2, 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
Theories of origin of mineral deposits and description of world's important mineral deposits.

400. Mineral Deposits Laboratory. W. H. Gross.
Course 9, IV Year; 3 hrs. per week, second term.

401. Geology of Canada. F. W. Beales.
Course 9, IV Year; 1 hr. lecture per week, both terms.
A reading survey of the physiography, historical geology, major structural features, and mineral deposits of the country.

402. Pleistocene Geology. R. E. Deane.
Course 9, IV Year; 2 hrs. lecture per week, both terms.
Study of the Pleistocene Deposits of North America and Europe.

403. Precambrian Geology. W. W. Moorhouse.
Courses 2 and 9, IV Year; 2 hrs. lecture per week, first term.
Precambrian formations of Canada—their rocks, distribution, relationships and economic features.

404. Precambrian Geology Laboratory. W. W. Moorhouse.
Course 2, IV Year; 1 hr. laboratory per week, first term.
Course 9, IV Year; 3 hrs. laboratory per week, both terms.
To accompany subject 403.

405. Mining Geology. G. B. Langford.
Courses 2 and 9, IV Year; 2 hrs. lecture per week, second term.
A course dealing with the application of geology to mining.
Reference book: Mining Geology—McKinstry.

406. Mining Geology Laboratory. G. B. Langford.
Course 9, IV Year; 3 hrs. per week, first term.

407. Petroleum Geology. J. B. Currie.
Courses 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
The origin, nature, and occurrence of petroleum and natural gas deposits and the extraction of these substances from the earth.

408. Petroleum Geology Laboratory. J. B. Currie.
Courses 5g and 9, IV Year; 3 hrs. per week, second term.
Accompanying subject 407.

409. Stratigraphy and Sedimentation. F. W. Beales.
Course 9, III Year; 2 hrs. lectures per week, second term.
Description, classification and interpretation of sedimentary rocks and rock units.

410. Stratigraphic and Sedimentary Field Work. F. W. Beales.
Course 9, III Year; 2 hrs. per week, second term.
Field work along the Niagara Escarpment.

411. Geological and Mineralogical Field Work.
Courses 2 and 9, III Year; 7 days.
A field trip following the April examination to the Bancroft and Madoc areas of Ontario.

412. Geological Field Trips (Glacial Geology).

Courses 2 and 9, IV Year. Two trips.

During the fall trips will be made to points of interest near Toronto.

413. Physical Geology. P. A. Peach.

Course 5g, III Year.

A reading course during the summer preceding the III Year. A special examination will be held early in October. Students who do not pass this examination will be required to write the examination in Subject 380 in January.

414. Geological Field Trips (Economic and Mining).

Course 9, IV Year. Two trips, each ½ day.

Trip to gypsum mine and cement plant.

415. X-Ray Crystallography. E. W. Nuffield.

Course 5m, IV Year; 2 hrs. lectures per week, second term.

X-ray diffraction methods and their application in the study of crystalline materials.

HEAT ENGINES

No laboratory reports to be written outside of assigned teaching hours.

420. Elementary Heat Engines. P. B. Hughes.

Course 3, II Year; 2 hrs. lecture per week, second term.

The history and development of heat engines, the principles upon which they operate, and the characteristic features of the different kinds of engines used in practice. The First and the Second laws of thermodynamics.

Text book: Thermodynamics—Obert.

Reference books: Thermodynamics of Heat Power—Faires. Steam, Air and Gas Power—Severns, Degler and Miles.

421. Engineering Thermodynamics. F. C. Hooper.

Course 3, III Year; 2 hrs. lectures per week, both terms.

A continuation of subject 420.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer. Regeneration.

Text book: Thermodynamics—Obert.

422. Heat Engineering. R. C. Wiren, F. C. Hooper, W. A. Wallace.

Course 3, III Year; 2 hrs. lecture per week, first term; 1 hr. lecture per week, second term.

Steam Generators. Combustion calculations; analysis of fuels and products of combustion; boiler tests and heat balance; principles of design of boilers, furnaces, stokers, pulverised fuel, oil and gas firing equipment, economizers, air heaters, superheaters, feed-water heaters.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, McNaughton, Zerban and Nye.

Internal Combustion. Types and operation; performance and testing; basic characteristics and principles of design; carburation; fuel injection; governing.

Text book: Internal Combustion Engines—Obert.

Reference book: Internal Combustion Engines—Fraas.

Heat Transfer and Air Conditioning. Conduction, convection, radiation, and combined mechanisms of heat transfer. Air and water vapour mixtures, requirements for comfort and industrial processes; the use of psychrometric charts; heating, cooling, humidifying and dehumidifying processes; calculation of air conditioning loads; air conditioning systems and equipment.

Reference book: A.S.H.R.A.E. Guide.

423. Heat Engineering Laboratories. R. C. Wiren, F. C. Hooper, W. A. Wallace, R. W. P. Anderson, W. J. Moroz, C. H. Miller.

Courses 3 and 5t, III Year; 1 three-hour laboratory period per week, both terms.

Course 7, III Year; 1 three-hour laboratory period per week, first term.

Courses 4 and 6, III Year; 1 three-hour laboratory period per week, second term.

The laboratory work is designed to assist in clearer understanding of theory and practical applications, and consists of selected experiments in four laboratories: Heat Engine laboratory, Fuel Testing laboratory, Heat Transfer laboratory, Refrigeration and Air Conditioning laboratory.

The work on Heat Engines deals with the timing of engines, measuring indicated and brake horse-power, the use of power plant instruments, testing of air compressors, steam engines, steam turbines, internal combustion engines and gas turbines under various conditions, steam calorimetry and the solution of practical problems on steam plants, internal combustion engines, and gas turbines.

The Fuel Testing includes analysis of fuels and products of combustion, knock rating of gasolines, fuel calorimetry, etc.

The work on Heat Transfer deals with temperature measurement, tests on insulation and heat exchangers of various kinds.

The work on air conditioning deals with the use of instruments and charts, air conditioning standards, the solution of practical problem, and testing of air conditioning equipment.

424. Heat Power Engineering. R. C. Wiren.

Course 3, IV Year; 2 hrs. lecture per week, both terms.

A continuation of subjects 421 and 422. Evaporators and miscellaneous heat exchangers. Condensers and auxiliary power plant equipment. Theory and design of turbines. Power plant cycles including reciprocating engines and turbines. Cycles for high pressures and temperatures. Superheating, reheating, regenerative binary-fluid and supercritical pressure cycles. Steam generators employing forced circulation, indirect evaporation and pressure combustion. Power plant heat balance and efficiencies. Design of power plant equipment. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Heat and Thermodynamics—Zemansky. Engineering Thermodynamics—Obert, Lee and Sears, Soo, Van Wylen, Hawkins and Jones. Steam Power Plants—Gaffert, Zerban and Nye. Steam Turbines—Church, Salisbury, Lee, Shepheard.

425. Internal Combustion. W. A. Wallace.

Course 3, IV Year; 1 hr. lecture per week, both terms.

A survey of present and potential fuel resources. Characteristics of fuels and their combustion requirements. Operating cycles and losses involved, for both the reciprocating engine and the turbine plant. The theory of superchargers and rotary compressors. Factors governing the selection of equipment for an I.C. plant.

Reference book: Internal Combustion Engines—Obert.

426. Heat Engineering Laboratories. R. C. Wiren, F. C. Hooper, W. A. Wallace, A. B. Allan, R. W. P. Anderson, C. H. Miller, W. J. Moroz.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 5 hrs. laboratory per week, second term.

Course 5t, IV Year; 3 hrs. laboratory work per week, both terms.

A continuation and extension of the work covered in the III Year laboratory subjects consisting of selected experiments in four laboratories: Heat Engine laboratory, Fuel Testing laboratory, Heat Transfer laboratory, Refrigeration and Air Conditioning laboratory.

In the Heat Engine laboratory complete tests are made of various engines such as simple, compound and uniflow steam engines, impulse and reaction type steam turbines, gas, oil and gasoline engines. In each case an analysis is made of the thermal cycle involved, a complete set of experiments is performed and the results plotted to show clearly to the student the effect of various alterations in adjustment on the results obtained. A complete boiler test is performed and all calculations are made for a heat balance. An analysis is made of cycles used in gas turbines and jets and complete tests are performed on a gas

turbine plant and on a free-piston engine. Problems involving variable specific heat are studied.

In the Fuel Testing laboratory the octane rating of gasoline samples is determined by A.S.T.M. methods and fuel injection spray characteristics are studied with special test equipment.

In the Heat Transfer laboratory tests are made on heat exchangers.

In the Air Conditioning and Refrigeration laboratory tests are performed on complete air conditioning systems, and complete refrigerating plants.

427. Theory of Heat Engines. R. C. Wiren.

Course 2, III Year; 1 hr. lecture per week, both terms.

Thermodynamics of gases and vapours as applied to engines, nozzles, turbines, compressors, heat exchangers, refrigeration plants, and air conditioning systems. Analysis of vapour and gas power cycles.

Text book: Basic Thermodynamics—Brown.

Reference books: Engineering Thermodynamics — Young, Ebaugh. Thermodynamics of Heat Power—Faires.

428. Heat Engine Laboratory. R. C. Wiren, F. C. Hooper, W. A. Wallace. R. W. P. Anderson, W. J. Moroz, C. H. Miller.

Course 2, III Year; 3 hrs. per week, second term.

Experiments with steam and internal combustion engines, compressed air, etc.

429. Refrigeration and Air Conditioning. F. C. Hooper.

Course 5t, IV Year; 2 hrs. lecture per week, first term.

The thermodynamic cycles and processes of special interest in refrigeration are outlined and the properties of ideal and actual refrigerants examined. Basic psychrometric processes are reviewed and related to air conditioning system performance.

Text book: Theory of Mechanical Refrigeration—Sparks and Di Ilio.

Reference book: A.S.H.R.A.E. Guide.

430. Heat Power Engineering. R. C. Wiren.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Application of Thermodynamics to the design of power plant equipment. Analysis of high pressure and high temperature vapour cycles. Superheating, reheating, regenerative, binary-fluid and supercritical pressure cycles. Steam generators employing forced circulation, indirect evaporation and pressure combustion. Steam turbines, power plant heat balance and efficiencies. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, Zerban and Nye. Steam Turbines—Church, Salisbury, Lee. Engineering Thermodynamics—Obert, Keenan, Hawkins and Jones.

431. Theory of Heat Engines. P. B. Hughes.

Course 6, III Year; 2 hrs. lecture per week, first term.

The theory and practice of heat engines, including a study of fundamental principles involved, an appraisal of theoretical developments, and a survey of the corresponding practical applications.

Text book: Thermodynamics of Heat Power—Faires.

432. Heat Transfer. C. H. Miller.

Course 8, IV Year; 2 hrs. lecture per week, second term.

Basic principles, definitions, units and dimensional analysis. Conduction in the steady and the unsteady states. The heat source within a conducting body. Free and forced convection. Condensing and boiling. Radiation. Combined effects of conduction, convection and radiation. Instrumentation and experimental methods.

Text book: Elements of Heat Transfer and Insulation—M. Jakob and G. A. Hawkins.

433. Heat Transfer. F. C. Hooper.

Courses 5t and 5n, IV Year; 2 hrs. lecture per week, second term.

Steady state and transient conduction, surface and gas radiation, convection, boiling, condensation and combined mechanisms are considered. Special attention is given to analogue and computational procedures and to consideration of the manner in which novel or complex problems may be approached.

Text book: Heat Transmission—McAdams.

434. Engineering Thermodynamics. A. B. Allan.

Course 1, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The fundamentals of engineering thermodynamics. The First and Second Laws. Properties of substances. Heat transfer. Heat exchangers. Compressors, fans, pumps, reciprocating engines and turbines. Vapour and gas power cycles. Refrigeration. Air-conditioning.

Text book: Basic Thermodynamics—Brown.

Reference book: Engineering Thermodynamics—Ebaugh.

435. Theory of Heat Engines. P. B. Hughes.

Course 4, III Year; 2 hrs. lectures per week, second term.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles used in practice for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer.

Text book: Thermodynamcis—Faires.

436. Internal Combustion. A. B. Allan.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Analysis of the processes and fundamental problems of internal combustion machines. Consideration of the deviations from ideal behaviour. Fuels, combustion, ignition, detonation and other combustion problems. Experimental techniques in the study of internal combustion machines. A consideration of engine design.

Text book: Internal Combustion Engines—Obert.

Reference book: Internal Combustion Engines—Lichty.

437. Thermodynamics. R. W. P. Anderson.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

A development of the fundamental laws of thermodynamics and of their application in engineering. Internal combustion and steam power, refrigeration, heat transfer, psychrometry and air conditioning.

Text book: Elements of Thermodynamics and Heat Transfer—Obert.

438. Heat Engineering. R. C. Wiren, F. C. Hooper, W. A. Wallace, S. Sandler.

Course 5c, III Year; 2 hrs. lectures per week, both terms.

Steam Generation: Analysis of thermodynamic systems used in industrial plants and power plants; heat transfer and insulation; fuels and combustion; power plant testing; principles involved in the design of boilers, furnaces, stokers, pulverised coal, oil and gas firing equipment, economisers, air heaters, superheaters, feedwater heaters and feedwater treatment plants.

Text book. Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, McNaughton, Zerban and Nye.

Internal Combustion: Types of engines and turbines and their operation characteristics; performance and testing; principles involved in design; fuel systems; governing.

Text book: Internal Combustion Engines—Obert.

HYDRAULICS AND FLUID MECHANICS

No laboratory reports to be written outside of assigned teaching hours.

440. Fluid Mechanics. G. R. Lord, L. E. Jones, C. L. Proctor, H. J. Leutheusser, J. F. Keffer.

Courses 1, 3, and 4, III Year; 2 hrs. lectures per week, both terms.

Attention is given to the development and discussion of the fundamental principles of fluid flow. These principles are illustrated by suitable practical problems connected with fluid mea-

surements, flow of fluids in pipes and open channels, with a brief discussion of the resistance of submerged bodies, dimensional analysis and similarity studies.

441. Fluid Mechanics Laboratory. G. R. Lord, L. E. Jones, C. L. Proctor, H. J. Leutheusser, J. F. Keffer.

Courses 1 and 3, III Year; one 3-hr. laboratory period per week, second term.

Course 4, III Year; one 3-hr. laboratory period per week, first term.

This laboratory course is planned to illustrate the principles considered in the lecture courses in fluid mechanics. Experimental work in the laboratory utilizes a wide variety of apparatus and equipment concerned with fluid flow, while problems undertaken in the study room provide a link with general engineering practice.

443. Hydraulics. G. R. Lord.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

The general field of applied hydraulics and fluid mechanics is studied under the topics: hydrology; hydro-electric power plants and auxiliaries; conservation and flood control; canals, pipelines, etc., under both steady and unsteady conditions; hydraulic machinery, fans, compressors, turbines, pumps, etc., design, selection and operation; power and control circuits; flow of compressible fluids; similarity and model investigations; industrial applications.

444. Hydraulic Laboratory. G. R. Lord, L. E. Jones, J. F. Keffer.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 5 hrs. laboratory per week, second term.

Experimental work is carried out in the laboratory on various types of pumps, turbines, fans, centrifugal compressors and on hydraulic models. In addition computation problems involving open channel flow, water power studies, pumps and turbine studies, water hammer phenomena, fans and ductwork, and other advanced flow problems are considered. General problems involving compressibility of gases are considered.

445. Hydraulic Engineering. W. D. Baines.

Course 1, IV Year; 2 hrs. lectures per week, both terms.

Applications of fluid mechanics to civil engineering problems, particular discussion of flow in pipes and open channels, water hammer, pumps, turbines and fluid couplings. Theory and applications of hydrology including precipitation, run-off, snowmelt, evaporation and hydrograph analysis.

446. Hydraulic Engineering Laboratory. G. R. Lord, L. E. Jones, W. D. Baines, H. J. Leutheusser.

Course 1, IV Year; one 1½-hr. laboratory period per week, first term; one 3-hr. laboratory period per week, second term.

Experimental studies of hydraulic models, turbines and pumps are carried out. Problems assigned in the study rooms deal with channel flow and other hydraulic features connected with water power installations, flood control, water supply and drainage systems.

449. Treatment of Technical Data. L. E. Jones.

Course 3, II Year; 2 hrs. lecture per week, second term.

Presentation of data; approximate nature of technical data; role played by mathematics; general numerical methods; methods of organizing data for computation; methods of analyzing technical data; elements of curve-fitting and statistical treatment.

452. Fluid Mechanics. L. E. Jones, H. J. Leutheusser.

Course 6, III Year; Course 8, IV Year; 2 hrs. lectures per week, first term.

The fundamentals of fluid flow as generally encountered in industry. Fluid properties, fluid statics, energy relations, dimensional analysis and dynamic similarity, flow in pipes and channels, resistance of submerged bodies, effects of viscosity and compressibility, lubrication, pumps and other hydraulic machines.

453. Fluid Mechanics Laboratory. G. R. Lord, L. E. Jones, H. J. Leutheusser.

Course 6, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit of correlating flow fundamentals with industrial applications.

454. Fluid Flow and Pumping Systems. L. E. Jones, H. J. Leutheusser, J. F. Keffer.

Course 2, III Year; 3 hrs. lectures per week, first term.

A discussion of the fundamental principles of fluid flow, with special attention to problems encountered in mining.

455. Fluid Flow and Pumping Systems Laboratory. G. R. Lord, L. E. Jones, H. J. Leutheusser, J. F. Keffer.

Course 2, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit correlation of flow fundamentals with mining applications.

MACHINERY

No laboratory reports written outside of assigned teaching hours.

461. Mechanical Engineering. W. G. McIntosh.

Course 3, II Year; 1 hr. lecture per week, first term.

Prior to registering in Second Year, the student is required to study the prescribed text, covering the topics of design materials and manufacturing methods and processes. The lecture work will involve discussion of the text matter, as well as new materials

and processes. The final examination (in January) will cover both the prescribed study and the lecture work.
Text book: Manufacturing Processes (4th edition)—Begeman.

463. Mechanical Engineering. W. G. McIntosh, R. T. Waines.
Course 4, II Year; 2 hrs. lectures per week, both terms.
Materials of design and production methods. In addition, standards, tolerances, limits, fits and mechanical drafting room practice will be explained.
Text books: Manufacturing Processes—Begeman. Drawings and Drafting Room Practice. A.S.A.

464. Mechanical Engineering Laboratory. I. W. Smith, R. T. Waines.
Course 4, II Year; 3 hrs. laboratory per week, second term.
An introduction to the principles and techniques of fine measurement and instrumentation. Problems dealing with tolerances, force analysis, etc., will also be given.

465. Dynamics of Machines. D. L. Allen.
Course 3, II Year; 3 hrs. lectures per week, both terms.
Basic equations for accelerated motion of mass are developed and applied to the analysis of machine elements. Velocity, acceleration, force distribution, speed fluctuation and balancing of machines are considered. Standard linkages, cams, gears, flywheels, governors and gyroscopes are given specific attention.
Text books: Engineering Dynamics—Hooper and Smith. Kinematics and Dynamics of Machinery—Maxwell.

466. Dynamics of Machines Laboratory. I. W. Smith, R. T. Waines, D. L. Allen.
Course 3, II Year; 1½ hrs. laboratory per week, both terms.
The work in the laboratory will illustrate the principles covered in lecture subject 465.

467. Machine Design. I. W. Smith, G. E. Godfrey.
Courses 3 and 4, III Year; 2 hrs. lectures per week, both terms.
Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.
Text books: Course 3; Design of Machine Elements—Faires. Course 4; Design of Machine Elements—Spotts.

468. Machine Design Laboratories. I. W. Smith, R. T. Waines, G. E. Godfrey.
Course 3, III Year; 4½ hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.
Course 4, III Year; 3 hrs. laboratory per week, both terms.
Course 7, III Year; 3 hrs. laboratory per week, first term.
Design laboratory work will be taken by students in all courses

listed above. This will involve the design of machine elements with the object of illustrating the work covered in the lecture subjects in Machine Design. Sketching and drafting will be given with a view to developing the student's judgment and sense of proportion in design and the application of drafting room standards.

Mechanical laboratory work will be taken by Course 3. This will include selected experiments in speed measurement, oil testing, balancing, vibrations, testing of power drives, etc.

469. Machine Design. R. T. Waines.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The design and selection of machinery and equipment met with in metallurgical plants, and in mining work.

Text book: Design of Machine Elements—Faires.

470. Machine Design Laboratory. I. W. Smith, R. T. Waines.

Courses 2, 6 and 8, IV Year; 3 hrs. laboratory per week, second term.

Problems worked out in the laboratory, designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

471. Machine Design. J. VandeVegte.

Courses 5e, 5m, 5n, 5s, 5t, III Year; 1 hr. lecture per week, both terms.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Spotts.

472. Machine Design Laboratory. I. W. Smith, R. T. Waines, J. VandeVegte.

Courses 5e, 5m, 5n, 5s, 5t, III Year; 3 hrs. laboratory per week, both terms.

The work in the laboratory will consist of the analytical solution of problems, illustrating the principles involved in the lecture course, and the standard practice in making assembly and detail machine drawings.

473. Machine Design. I. W. Smith.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

This is a continuation of subjects 467 and 466. It will involve the design of various machine elements and equipment including machine frames, hooks, hoisting equipment, crankshafts, gears (helical, herringbone, bevel, screw, and worm), springs, clutches, brakes, thin and thick wall vessels.

An introduction will be given to the study of vibration problems encountered in high speed engines and machines.

Text books: Design of Machine Elements—Faires. Mechanical Vibrations—Thomson.

474. Machine Design Laboratories. I. W. Smith, R. T. Waines.

Course 3, IV Year; 5 hrs. laboratory per week, both terms.

Advanced laboratory work involves both analysis and design of machine elements, machine units, and complete machines. The selection of problems is made with a view to giving the student as broad a coverage as possible and providing experience in combining of elements to form a machine of smooth and harmonious design. Some of this work will involve special shafting problems including graphical solutions, critical speeds, and multiple supports.

Work will be given in the Mechanical Laboratory on gauging and fine measurements, experimental stress analysis, vibration, and bearing testing.

475. Machine Design. R. T. Waines.

Course 7, III Year; 2 hrs. lectures per week, first term.

Force analysis; mechanics; velocities, accelerations and inertia forces in machines; principles of stress analysis and the design of various machine elements, including shafting, bearings, belts, gears, etc.; also an introduction to work on speed fluctuation, vibrations and balancing.

Text book: Design of Machine Elements—Faires.

476. Manufacturing Processes. B. M. M. Carpendale, D. J. Clough, P. B. Hughes.

Course 4, IV Year; 2 hrs. lectures per week, second term.

The design and control of manufacturing processes and systems.

477. Manufacturing Processes Laboratory. B. M. M. Carpendale, D. J. Clough, P. B. Hughes.

Course 4, IV Year; 3 hrs. laboratory per week, second term. Laboratory based on subject 476.

478. Machine Design. J. VandeVegte.

Course 5t, IV Year; 2 hrs. lectures per week, second term.

A series of lectures on design methods related to heat engines, including force analysis, speed fluctuation, flywheel design, governors, vibrations, high speed bearings, and thermal stress.

Reference books: Mechanism and Dynamics of Machinery—Mabie and Ocvirk. Analysis and Lubrication of Bearings—Shaw and Macks. Design of Machine Elements—Faires.

479. Machine Design. R. T. Waines.

Course 6, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The design of various machine elements, particularly those likely to be met with in chemical plants, and an outline of the properties, production methods, and selection of materials used in machine equipment.

Reference books: Process Equipment Design—Hesse and Rushton. Principles of Machine Design—Berard, Waters and Phelps. Design of Machine Elements—Faires.

480. Elementary Control Theory. J. M. Ham, C. H. Miller, C. L. Proctor, J. VandeVegte.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

System characteristics, including response, feedback and control; equivalence of functioning elements; sensing elements; criteria for selection.

481. Elementary Control Theory Laboratory. J. M. Ham, C. H. Miller, C. L. Proctor, J. VandeVegte.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Problems and laboratory experiments related to subject 480 are dealt with.

MATHEMATICS

490. Calculus. J. Burr, G. F. D. Duff, J. H. Lindsay, R. A. Ross, C. J. Scriba, F. A. Sherk, F. Sweet, J. Vanstone.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

Derivation of the fundamental formulas of the differential and integral calculus, with applications to problems concerning curves, areas, volumes, lengths. Problems are dealt with in the drafting room as outlined in subject 275.

491. Calculus. F. V. Atkinson, G. de B. Robinson, P. G. Rooney, M. Stephens, J. H. Lindsay.

Courses 1, 2, 3, 4, 6, 8 and 9, II Year; 2 hrs. lectures per week, both terms.

Continuation of subject 490. The elementary theory reviewed and extended, with special attention to applications in engineering. Introduction to simple differential equations. Problems are dealt with in the drafting room as outlined in subjects 284, 285, 286, 287, 288 and 289.

492. Analytical Geometry. G. F. D. Duff, F. V. Atkinson, R. A. Ross, C. J. Scriba, F. A. Sherk, J. Vanstone, J. H. Lindsay.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 1 hr. lecture per week, both terms.

The Secondary School course in the geometry of the plane is extended and is followed for the greater part of the session by an algebraic treatment of the geometry of planes, lines, and quadric

surfaces. Problems are dealt with in the drafting room as outlined in subject 275.

493. Calculus and Differential Equations. W. Kahan.

Course 7, II Year; 2 hrs. lectures per week, both terms. 2 hrs. computation per week, both terms.

The definite integral, expansion in series, ordinary differential equations, partial differentiation, multiple integration and an introduction to partial differential equations.

494. Least Squares. O. J. Marshall, H. L. Macklin, B. J. Haynes.

Course 1, II Year; 3 hrs. laboratory per week, second term.

The general principles of probability of errors, elementary problems illustrating the application of Least Squares to the adjustment of observations, empirical constants and formulae.

No laboratory reports shall be written outside the assigned teaching hours.

Text books: Least Squares in Engineering—Marshall and Macklin.

495. Mathematical Problems. W. J. R. Crosby, D. A. S. Fraser, D. K. Sen. W. J. Webber, R. Wormleighton, D. W. H. Shale.

Course 5, II Year; 3 hrs. problems per week, both terms.

The weekly sheet of prepared problems will be based on the content of courses 501, 504, 505, and will provide training in operating the routine processes of the Calculus and will illustrate these by applications in Numerical Methods, Mechanics and Geometry. Students will be given an opportunity to have their difficulties in these courses cleared up.

501. Probability and Numerical Methods. D. A. S. Fraser, R. Wormleighton.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Definition of probability; binomial, Poisson, and normal distributions; frequency; sampling distributions. Examples of estimation, hypothesis testing, control charts, regression, and analysis of variance. Finite differences; operators; interpolation; numerical integration and solution of equations; inversion of matrices.

502. Algebra and Geometry. Mrs. C. C. Krieger-Dunaj, D. W. H. Shale.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Complex numbers, elementary theory of equations, rational functions, vectors and matrices, coordinate systems, planes, lines, standard surfaces of the second degree, principal axes.

503. Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Introduction of differential and integral calculus with applications; limits, power series, the exponential and logarithmic

functions; trigonometric and hyperbolic functions and their inverses.

Text books: Calculus—Sherwood and Taylor. Introduction to the Calculus—Beatty and Jenkins.

504. Differential Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Ordinary and partial differentiation, differentials, Taylor's theorem for functions of one or more variables, maxima and minima, transformations, convergence and uniform convergence, differential equations of the first order, linear differential equations with constant coefficients.

Text book: Advanced Calculus—Sokolnikoff.

505. Integral Calculus. W. J. Webber, D. W. H. Shale.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Methods of indefinite integration, definite integrals, multiple integrals, line and surface integrals, orthogonal functions.

Text book: Advanced Calculus—Sokolnikoff.

507. Differential Equations. J. Burr, Mrs. C. C. Krieger-Dunaj.

Courses 1, 6 and 8, III Year; 1 hr. lecture per week, both terms.

First order equations solvable by quadratures, linear equations of first and second orders, linear equations with constant coefficients of higher order.

Text books: Elementary Differential Equations—Kells. Differerential Equations—Reddick.

508. Theory of Functions. Mrs. C. C. Krieger-Dunaj.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

Complex numbers, limits and series, analytic functions, Cauchy's theorem, Taylor and Laurent series, singularities and their significance, analytic continuation, contour integration, conformal mapping of one plane region on another.

Text books: Functions of a Complex Variable—Phillips. Theory of Functions—Copson. Theory of Functions as applied to Engineering Problems—Rothe, Ollendorf, and Pohlhausen. Introduction to Complex Variables and Applications—Churchill.

509. Differential Equations. Mrs. C. C. Krieger-Dunaj.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation with constant coefficients, operator methods, the linear partial differential equation, particular equations of the second order.

Text books: Differential Equations—Piaggio. Intermediate

Differential Equations—Rainville. Fourier Series and Boundary Value Problems—Churchill.

510. Statistics. G. S. Watson.

Course 8, IV Year; 2 hrs. lectures per week, first term.

An introduction to the statistical methods used in the analysis and control of production processes.

511. Differential Equations. D. W. H. Shale, D. H. Miller.

Courses 3 and 4, III Year; 2 hrs. lectures per week, both terms.

Course 3, III Year; 1½ hrs. problems per week, first term; 3 hrs. problems per week, second term.

First and second order ordinary differential equations, operational methods, variation of parameters, solution in series, Fourier series, Bessel and Legendre functions, the Laplace transform, applications to first and second order partial differential equations, applications to problems in fluid flow systems, heat conduction, vibrating systems and stress analysis.

512. Probability and Statistics. D. B. DeLury.

Course 4, II Year; 2 hrs. lectures per week, both terms.

Frequency distributions and probability laws; binomial, Poisson, and normal distributions and the treatment of samples drawn from them; tests of significance and confidence limits; control charts; introduction to the analysis of variance.

513. Probability and Statistics Laboratory. D. B. DeLury, D. J. Clough, E. E. Pickett.

Course 4, II Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises associated with the material of the companion lecture subjects.

514. Numerical Analysis. D. B. DeLury, W. Kahan.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Vectors, matrices, inversion of matrices, regression theory and calculations, elements of the design of experiments, theory of sampling.

515. Numerical Analysis Laboratory. D. B. DeLury, W. Kahan, D. J. Clough.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Practice in the numerical analysis methods and techniques dealt with in the lecture subject. Practical problems, as well as problems of a fundamental mathematical nature, will be covered.

516. Differential Equations. Problems. C. A. Wrenshall.

Course 1, III Year; 1½ hrs. laboratory per week, both terms.

Problems based on the content of Lecture Course 507.

Problems must be done during the laboratory period.

MATHEMATICS, APPLIED

520. Applied Mathematics in Engineering. Staff in Mechanical Engineering.

Course 3, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term; 3 hrs. problems per week, first term; 2 hrs. problems per week, second term.

Dimensional analysis and similarity, numerical methods, relaxation techniques, approximate solutions, digital and analogue computation, introduction to statistics.

521. Differential Equations of Mathematical Physics. D. Naylor.

Course 5, IV Year; 2 hrs. lectures per week, both terms.

The underlying theory and important particular equations, including eigenvalues and eigenfunctions, Fourier series, spherical and cylindrical harmonics, vibration of strings, membranes, and rods, sound waves, water waves, equation of heat conduction.

Text books: Fourier series and Boundary Value Problems—Churchill. Modern Operational Mathematics in Engineering—Churchill. Partial Differential Equations of Mathematical Physics—Webster.

523. Adjustment of Observations. H. L. Macklin.

Courses 1b, IV Year; 3 hrs. per week, second term.

Problems illustrating the application of Least Squares to the adjustment of observed data, with particular reference to surveying measurements.

No laboratory reports shall be written outside the assigned teaching hours.

524. Operations Research I.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

Methods for establishing economic optima in industrial operations; mathematical models for allocation of resources, inventory and production; applied probability in machine interference, maintenance and replacement, competition and bidding. Measures of effectiveness, evaluation of objectives, tests of validity.

525. Operations Research I Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, both terms. Practical work to accompany subject 524.

526. Operations Research II.

Course 4, IV Year; 2 hrs. lectures per week, second term. Techniques of analytical, iterative and statistical procedures used in Operational Research.

527. Operations Research II Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, second term. Practical work to accompany subject 526.

METALLURGICAL ENGINEERING

530. Metallurgy. The Staff in Metallurgy.

Course 8, II Year; 2 hrs. lectures per week, both terms.

An introductory course describing the theory and practice of metallurgical processes and operations.

531. Principles of Extractive Metallurgy. L. M. Pidgeon.

Course 8, III Year; 2 hrs. lectures per week, both terms.

A general discussion of the fundamental principles of extractive metallurgy with reference to the production of the more important metals.

532. Principles of Extractive Metallurgy Laboratory. H. U. Ross, S. N. Flengas.

Course 8, III Year; 3 hrs. laboratory per week, first term; 6 hrs. continuous laboratory per week, second term.

Experiments in pyrometry, furnaces, roasting, smelting, leaching, retorting, refining, electrolysis designed to illustrate the principles underlying these operations.

One laboratory report per week.

533. Principles of Physical Metallurgy. G. B. Craig, W. C. Winegard.

Courses 5m and 8, III Year; 2 hrs. lectures per week, both terms.

A discussion of the structure of solids with particular reference to x-ray methods of investigation; the solidification of metals, and the plastic deformation of metals with reference to the dislocation theory.

534. Principles of Physical Metallurgy Laboratory. W. C. Winegard.

Courses 5m, 5n and 8, III Year; 3 hrs. laboratory per week, both terms.

Practical work relating to subject 533.

535. Metallurgical Thermodynamics. I. G. B. Craig.

Course 8, III Year; 2 hrs. lecture per week, both terms.

The physico-chemical principles of metallurgy.

536. Metallurgical Problems Laboratory. H. U. Ross, S. N. Flengas, G. B. Craig.

Course 8, III Year; 4 hrs. laboratory per week, both terms.

Problems in chemistry, physical chemistry and thermodynamics as applied to metallurgical processes and operations relating to subjects 531 and 535.

538. Physical Metallurgy. H. U. Ross.

Course 1, II Year; Course 2, IV Year; 2 hrs. lectures per week, second term.

A short course on the structure and mechanical properties of metals and alloys and on the influence of heat and mechanical

treatment upon these properties. Reference is made particularly to steels and the more-important non-ferrous alloys. Welding and corrosion of metals is also included.

539. Metallurgy. H. U. Ross.
Courses 2 and 9, III Year; 1 hr. lecture per week, second term.
An introductory course describing the theory and practice of metallurgical processes and operations.

540. Metallurgical Problems Laboratory. H. U. Ross.
Course 8, II Year; 2 hrs. laboratory per week, second term.
Problems in chemistry and physical chemistry as applied to metallurgical processes relating to subject 530.

550. Non-Ferrous Extractive Metallurgy. L. M. Pidgeon.
Course 8, IV Year; 1 hr. lecture per week, both terms.
Extractive metallurgy of the non-ferrous metals, including electrometallurgy.

551. Ferrous Extractive Metallurgy. H. U. Ross.
Course 8, IV Year; 1 hr. lecture per week, both terms.
Extractive metallurgy of iron and steel.

552. Extractive Metallurgy Laboratory. H. U. Ross, S. N. Flengas.
Course 8, IV Year; 6 hrs. continuous laboratory per week, first term.
A continuation of subject 532.
Four laboratory reports per term.

553. Metallurgical Thermodynamics II. G. B. Craig.
Course 8, IV Year; 2 hrs. lectures per week, both terms.
A study of chemical equilibria at high temperatures in extractive metallurgy.

554. Metallurgical Problems Laboratory. G. B. Craig, S. N. Flengas.
Course 8, IV Year; 2 hrs. laboratory per week, both terms.
Problems relating to subjects 550, 551 and 553.

555. Metallurgy. L. M. Pidgeon.
Courses 2 and 9, IV Year; 1 hr. lecture per week, both terms.
The extractive metallurgy of the common metals, together with the calculations necessary to understand metallurgical processes.

556. Metallurgy Laboratory. H. U. Ross, S. N. Flengas.
Course 2, IV Year; 6 hrs. continuous laboratory per week for one half of second term.
Similar to subject 532.
One laboratory report per week.

557. Physical Metallurgy. W. C. Winegard, G. B. Craig.
Courses 5m and 8, IV Year; 2 hrs. lectures per week, both terms.
A continuation of subject 533 in which the heat treatment of ferrous and non-ferrous alloys is discussed.

558. Physical Metallurgy Laboratory. W. C. Winegard.
Course 8, IV Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.
Practical work relating to subject 557.

561. Physical Metallurgy. E. L. Holmes.
Courses 5a, 5c, 5e, 5g, 5n, 5s, 5t, III Year; 1 hr. lecture per week, both terms.
A short course in Physical Metallurgy; structure of metals and alloys; effects of mechanical distortion and heat treatment on structure; relation between structure and mechanical properties; and properties of some steels and non-ferrous alloys.

562. Physical Metallurgy Laboratory. W. C. Winegard.
Course 5m, IV Year; 3 hrs. laboratory per week, second term.
Practical work relating to subject 557.

563. Physics of Metals Seminar. G. B. Craig, W. C. Winegard.
Course 5m, IV Year; 3 hrs. per week, both terms.
Each student prepares and presents seminars on topics concerning metal physics. The topics may include nucleation theory, dislocations, imperfections, electron theory, ferromagnetism, phase transformations, electrical properties, grain boundaries, metal surfaces, thermal properties, diffusion or any topic satisfactory to both staff and student.

564. Physical Metallurgy. W. C. Winegard.
Courses 3 and 4, II and IV Years; 2 hrs. lectures per week, both terms.
A general course in Physical Metallurgy, dealing with the structure of metals and alloys, with special reference to the ferrous alloys of practical importance. The influence of mechanical deformation, heat treatment, and composition on the structure is considered, and the relation between the structure and mechanical properties is examined.

565. Physical Metallurgy Laboratory. W. C. Winegard.
Courses 3 and 4, II Year; 3 hrs. laboratory per week for six weeks, second term.
A practical course illustrating the principles dealt with in subject 564. Experiments are conducted on the heat-treatment of ferrous and non-ferrous alloys.

566. Physical Metallurgy. E. L. Holmes.

Course 7, III Year; 2 hrs. lectures per week, second term.

A short course in physical metallurgy which includes the structure of solids, the liquid-solid transformation, phase diagrams, defects in the solid state, the effect of stress and temperature on metals and the relationship between structure and properties. Commercial alloys are discussed in terms of the above topics.

567. Physical Metallurgy Laboratory. W. C. Winegard.

Course 7, III Year; 1½ hrs. laboratory per week, second term.

Experiments are conducted to illustrate the essential features of subject 566. These include the examination of metals by metallographic and x-ray diffraction techniques.

MODERN LANGUAGES

610. English.

All Courses, I Year; 1 hr. lecture per week, both terms.

A course in essay writing, based on the study of examples of expository prose. Texts will be announced at the opening of the session.

611. English Literature.

All Courses, IV Year; 1 hr. lecture per week, both terms.

A course in the drama, the novel and poetry based on the study of the following texts: Shakespeare, *King Lear*; Synge, *The Playboy of the Western World* and *Riders to the Sea*; Miller, *Death of a Salesman*; Hawthorne, *The Scarlet Letter*; Hemingway, *The Sun Also Rises*; Golding, *The Lord of the Flies*; one additional play; Selections from the Major Poets, English and American (Charles M. Coffin, editor).

Students are expected to read the plays and novels during the summer preceding their entry into the Fourth Year. Term work will include assignments based on texts read during the summer, one substantial essay, and two class tests. Students who obtain a satisfactory term mark will not be required to write a final examination.

PHYSICAL EDUCATION

640. Physical Education.

All courses, I Year.

By order of the Board of Governors each first year student must register for, and satisfactorily complete, the University requirement in Physical Education. This requirement includes a medical examination by the University Health Service. Each year of failure to fulfil the regulations renders the student liable to a special fee of $50.00.

Physical Education credits may be earned by participation in

intercollegiate and intramural sports, swimming, water safety, and instructional classes.

Exemptions: (1) one year's satisfactory standing in physical education at this or any other University (2) if age is 30 years or more (3) ex-military service (4) completion of one year's course in the U.N.T.D., C.O.T.C. or U.R.T.P. (5) exemption by the University Health Service (6) special consideration.

PHYSICS

650. Properties of Matter; Mechanics and Heat. D. G. Ivey.

Course 5, I Year; 3 hrs. lectures per week, both terms.

Text book: Mechanics, Heat and Sound—Sears.

651. Properties of Matter; Mechanics and Heat Laboratory. D. G. Ivey, Miss K. M. Crossley and the staff in Physics.

Course 5, I Year; 3 hrs. laboratory per week, both terms; 1 hr. tutorial per week, both terms.

To accompany subject 650.

Twelve laboratory reports.

652. Physics. R. W. McKay.

Course 5, II Year; 3 hrs. lectures per week, both terms.

Fundamental theory of electricity and magnetism. Acoustic and electromagnetic waves. Interference, diffraction and polarization of light waves. Elementary atomic physics.

Text book: Currents, Fields and Particles—F. Bitter.

655. Physics Laboratory. R. W. McKay.

Course 5, II Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.

To accompany subject 652.

656. Physics of Solids and Fluids. F. S. Grant.

Courses 5e, 5g, 5m, 5s, III Year; 1 hr. lecture per week, both terms.

Elasticity, viscosity, equations of fluid motion, wave propagation, heat conduction, potential theory.

657. Thermodynamics and Kinetic Theory. J. C. Stryland.

Course 5, III Year; 2 hrs. lectures per week, both terms.

The fundamental principles of thermodynamics, kinetic theory, and statistical mechanics.

659. Physical Laboratory. J. C. Stryland.

Course 5, III Year; 3 hrs. laboratory per week, both terms.

To accompany subjects 656 and 657.

Twelve laboratory reports.

660. Optics. I. H. Gush.

Course 5s, III Year; 1 hr. lecture per week, both terms.

Geometrical Optics; interference.

Text books: Fundamentals of Optics—Jenkins and White. Principles of Optics—Born and Wolf.

661. Optics. I. H. Gush.

Course 5s, III Year; 3 hrs. laboratory per week, first term.

Supplementary to subject 660.

662. Nuclear Physics. K. G. McNeill.

Courses 5n, III Year; 1 hr. lecture per week, both terms.

Neutron physics, nuclear radiation detection techniques, introduction to reactor theory and shielding problems, health physics.

663. Atomic Physics. Miss E. J. Allin, K. G. McNeill, H. L. Welsh.

Courses 5e, 5c, 5g, 5m, 5n, 5s and 5t, IV Year; 3 hrs. lectures per week, both terms.

Introduction to quantum theory, atomic, molecular and nuclear physics.

664. Nuclear Engineering. D. G. Andrews, R. E. Jarvis.

Course 5n, IV Year; 1 hr. lecture per week, both terms.

Reactor kinetics, heat transfer problems in a reactor. Nuclear chemistry, technique and applications.

665. Physical Laboratory. The staff in Physics.

Course 5s, IV Year; 9 hrs. laboratory per week, both terms.

Courses 5c, 5m and 5n, IV Year; 6 hrs. laboratory per week, both terms.

To accompany the lecture subjects 663, 664, 666, and 669.

666. Optics II. H. L. Welsh.

Course 5s, IV Year; 2 hrs. lectures per week, both terms.

Polarization, diffraction, coherence and quantum effects.

Text books: Fundamentals of Optics—Jenkins and White. Principles of Optics—Born and Wolf. Optics of the Electromagnetic Spectrum—Andrews.

669. Introductory Quantum Mechanics. J. Van Kranendonk.

Course 5s, IV Year; 1 hr. lecture per week, both terms.

Text books: Elementary Wave Mechanics—W. Heitler. Introduction to Quantum Mechanics—L. Pauling and E. B. Wilson.

670. Theory and Application of Geophysical Methods. F. Grant.

Course 5g, IV Year; 2 hrs. lectures per week, both terms.

A course on the mathematical theory of magnetic, electrical, seismic and gravitational methods in applied geophysics.

671. Exploration Geophysics. G. F. West.

Course 9, IV Year; 1 hr. lecture per week, both terms.

An introduction the physical principles underlying the important methods of geophysical prospecting. Particular attention

is given to seismic, gravitational, magnetic and electromagnetic methods.

Text book: Introduction to Geophysical Prospecting—Dobrin.

672. Geophysics. F. Grant.

Course 5g, IV Year; 6 hrs. laboratory per week, both terms.

To accompany subject 670.

673. Geophysics. G. F. West.

Course 9, IV Year; 3 hrs. laboratory per week, both terms.

To accompany subject 671.

674. Physics of the Earth. J. T. Wilson.

Course 5g, III Year; 1 hr. lecture per week, both terms.

Introduction to gravitation, the figure of the Earth and isotasy, seismology and the internal constitution of the Earth; radioactivity, geothermal heat and the age of the Earth, tectonics of the Earth's crust, with special reference to geological aspects.

Text books: Physics and Geology—Jacobs, Russell and Wilson.

675. Physics of the Earth. M. G. Rochester.

Course 5g, IV Year; 1 hr. lecture per week, both terms.

Physical theories of seismology and the internal constitution of the Earth, gravity and the figure of the Earth, temperature and thermal history, geomagnetism and physics of the upper atmoshere, glaciology, mechanical properties of the Earth's interior.

Text books: Physics and Geology—Jacobs, Russell and Wilson. The Earth—Jefferys.

676. The Structure and Properties of Matter. J. N. P. Hume, J. D. Prentice, M. G. Rochester, A. D. May.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

An introduction to the mechanical, electrical, magnetic, thermal and optical properties of matter in terms of atoms.

677. Physics Laboratory. The Staff in Physics.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; twelve 3 hr. periods.

To accompany subject 676.

678. Engineering Data Processing. The Staff in Physics.

Course 4, IV Year; 2 hrs. lectures per week, first term.

A course in programming and coding for the digital computer.

679. Engineering Data Processing Laboratory. The Staff in Physics.

Course 4, IV Year; 3 hrs. laboratory per week, first term.

Practical work to accompany subject 678.

PRACTICAL EXPERIENCE

690. Practical Experience.

Students in the courses listed below are required to have, before graduation, practical work of a nature acceptable to the department concerned. This may be obtained during the summer vacations but work done before entering the Faculty may also meet the requirements. Instructions will be issued by the departments concerning the type of work which is acceptable. Practical experience certificate forms may be obtained from the departments and should be returned there when completed.

Course 1	600 hours
Course 2	6 months
Course 3	1200 hours
Course 4	1200 hours
Course 6	800 hours
Course 7	1200 hours
Course 8	800 hours
Course 9	6 months

SURVEYING

All students taking Field Work in subjects 710 to 720, inclusive, will be required to use Departmental Field Books.

No laboratory reports shall be written outside the assigned teaching hours.

710. Surveying. O. J. Marshall, H. L. Macklin, B. J. Haynes.

Courses 1, 2 and 9, I Year; 1 hr. lecture per week, first term.

General principles and practice of surveying with the tape, the transit, and the level, and computation of corrections, azimuths, bearings, latitudes and departures, co-ordinates and areas.

Text book: Surveying—Philip Kissam.

Reference books: Plane Surveying—Tracy. Elementary Surveying—Breed and Hosmer. Surveying—Breed.

712. Field Work. O. J. Marshall, H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Courses 1, 2 and 9, I Year; 3 hrs. per week, first term.

Practice in chaining; keeping of field notes; the use of the transit in surveying closed figures and traverse lines; plotting by co-ordinates; computing of areas; instrumental work with the level and calculating the volume of excavations.

714. Surveying. O. J. Marshall, B. J. Haynes.

Course 1, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Simple, reverse, compound and spiral curves as applied to Highway and Railroad surveying. Main features of mine and

hydrographic surveying. Construction surveying dealing with cross sectioning, earthwork, quantities, mass or haul diagram, super elevation, vertical curves, and layout of roads and sewers.

Text book: Route Surveys—Skelton.

715. Surveying. H. L. Macklin.

Courses 2 and 9, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Mine surveying, with problems related thereto. Simple curves, stadia and plane table topographical surveying. Practical determination of time, latitude and azimuth by methods adapted to the surveyor's transit.

Text book: Surveying for Civil Engineers—Kissam.

716. Surveying Laboratory. O. J. Marshall, H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Course 1, II Year; 3 hrs. per week, both terms.

First term: Field problems, in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy, and earth work quantities.

717. Surveying Laboratory. H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Courses 2 and 9, II Year; 3 hrs. per week, first term; 2 hrs. per week, second term.

First term: Field problems in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy and mine problems.

720. Survey Camp. O. J. Marshall, H. L. Macklin, B. J. Haynes, R. C. Gunn, S. G. Bird.

Course 1, III Year; Aug. 14 to Sept. 16; Courses 2 and 9, III Year; Aug. 21 to Sept. 16—Gull Lake or Dorset.

Course 1:

(*a*) Secondary Triangulation and Base Line Measurements.
(*b*) Highway and Railway Location.
(*c*) Cross Sectioning and Computation of Earthwork.
(*d*) Stadia and Plane Table Topography.
(*e*) Observations for Time, Azimuth, and Latitude.

Courses 2 and 9:

(*a*) Stadia and Plane Table Topography.
(*b*) Mine Surveying, using overhead stations.
(*c*) Shaft plumbing and use of Auxiliary Telescope.

Students in Courses 1, 2 and 9 will be required to take the

Survey Camp between the Second and Third Years; on failure to do so, this subject will be carried as a supplemental in the Third Year.

Application to defer attendance at the Camp must be made to the Secretary of the Faculty before July 15th.

721. Survey Camp. O. J. Marshall, B. J. Haynes.

Course 1b, IV Year; Sept. 5 to Sept. 16 (2 weeks) Dorset.

Triangulation, traverses, levelling and astronomical observations by precise methods.

THESIS

730. Thesis.

All courses, IV Year.

Every student in the Fourth Year is required to prepare a thesis on an approved subject. Instructions will be issued by the departments concerned.

In some cases written presentation is required, in others oral and written, or it may consist of a research problem followed by a written thesis or report.

SECTION IX. EXAMINATIONS

ANNUAL EXAMINATIONS

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations and laboratory work in each subject is 50% and a student must obtain a weighted average of 60% in order to pass in the work of the year. He shall be required to pass a supplemental examination in each subject in which he obtains less than 50%. Subjects will be weighted according to the number of hours devoted to them, the hours assigned to laboratory subjects being given one half the weight of those in lecture subjects.

5. Honours and scholarships will be awarded upon the basis of the weighted average.

6. Honours will be awarded to a student, who at the Annual Examinations passes in all written and laboratory subjects and who also obtains a weighted average of 75% on the work of the year.

7. Honour graduate standing will be granted to those who obtain honours in the final year and in one previous year.

8. A student who fails in the work of any year will be permitted, unless otherwise ineligible, to register in a subsequent session for the purpose of repeating the year, subject to the following conditions:

   (a) Only one such repetition will be allowed in the student's entire undergraduate course. A failure in an engineering course at any other institution will be counted in the same way as a failure at this university.

   (b) During any such repetition, the full programme of prescribed instruction must be taken.

   (c) Second, Third, or Fourth Year work may be repeated in the session immediately following that in which the failure occurs.

   (d) A student who fails in the work of the First Year but who obtained an average of 55% or over will, provided he is otherwise eligible, be allowed to repeat the work of the year in the following Session. All other students who fail in the work of the First Year must remain out for one Session before re-applying. If a student withdraws on or before 15th February he may re-apply for admission the following Session.

   Any student re-applying for admission to the First Year must file a new application (as outlined in Paragraph 7, Section V) with the Registrar of the University.

9. A student who has twice failed the work of his first year at this or another university shall not be granted admission to any course.

10. A student whose attendance at lectures or laboratories, or whose work, is deemed by the Council of the Faculty in which he is registered, to be unsatisfactory, may have his registration cancelled at any time by the Council of the Faculty.

11. A student should submit to Council immediately after its occurrence, evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

12. A student will not be allowed to write any examinations if he has not paid all fees and dues for which he is liable at that time.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on the 8th day of August, 1961. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 15th, and the fee named in Sec. VI, para. 11, received by the Chief Accountant not later than August 1st. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Chief Accountant, for the January examinations not later than December 1st and for the April examinations not later than March 1st.

3. Except under very exceptional circumstances, pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by the order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

EXTRA-CURRICULAR ACTIVITIES AND ACADEMIC CREDIT

It is in general desirable for students to engage to a reasonable extent in extra-curricular activities in order that they may not become too narrowly professional in interests and outlook, but it will be obvious that no academic credit or consideration can be given for such activities. Some offices in student organizations require quite large amounts of time for the proper performance of the duties connected with them, and it is therefore strongly recommended that students, particularly those whose academic records are not high, consult a senior member of Staff before allowing themselves to be nominated for such offices.

SECTION X. MEDALS, PRIZES, SCHOLARSHIPS, BURSARIES AND FELLOWSHIPS

Through the generosity of friends of the University, governments and commercial organizations, encouragement has been given to both undergraduate and graduate work in the various branches of engineering studies by establishing the following scholarships, prizes, bursaries, and medals.

Matriculation students are advised to consult the University of Toronto Calendar of Admission Awards for complete details of awards available to students entering this Faculty.

Where it is necessary to make application for an award it is so stated in the description and particulars are given as to how the application should be made. In all other cases the award is made on the recommendation of the Faculty Council and no application is necessary.

In order to be eligible for a medal, prize, scholarship, bursary, fellowship or other awards granted solely upon standing obtained at an annual or special examination or upon an essay, or term work, or other academic rating, a candidate must obtain honours at such annual or special examination or upon such essay, term work, or other academic rating unless the terms of the award or medal specify that standing lower than honours may be accepted.

When an award or medal is granted upon standing obtained on part of the work of any academic year the candidate must obtain standing but need not obtain honours in the work of the academic year as a whole, provided he obtains honours in the part concerned, unless the terms of the award or medal specify otherwise.

No medal, prize, scholarship, bursary, fellowship or other award will be granted to a candidate who is conditioned in any subject at an annual examination or in Physical Education unless the terms of the award or medal specify otherwise.

A candidate will not be permitted to receive more than one award in a session unless the statute establishing each of the awards concerned or the Calendar specifies otherwise. Only one of those marked by an asterisk may be held in any one year. A candidate who would, but for this provision, have received more than one award may have his name so published in the class lists.

A candidate who has spent two sessions in any year of an undergraduate course is not eligible to compete for any award at the annual examinations of that year.

Medals, after they have been suitably engraved, will be given without delay to the winners or forwarded to them by registered mail.

Awards granted to members of graduating classes other than awards for graduate study and research, will be paid in one instalment as soon as possible after the granting of the awards.

All other awards will be paid (i) if of the value of $100 or less, in one instalment on November 20 and (ii) if of the value of more than $100 in two equal instalments, the first on November 20 and the second on

January 20, in the session following the granting of the awards provided that no payment is made to a candidate (*a*) who is not in regular attendance upon lectures and laboratory classes in the Faculty, or if the Calendar so specifies, in the course in which the award is established or granted (*b*) who does not present at the Chief Accountant's Office before each payment a certificate of attendance upon lecture and laboratory classes signed by two senior members of the staff.

The Senate may, on the recommendation of the Faculty, permit a candidate to whom an award has been granted to postpone attendance upon lectures and laboratory classes for one year. Further postponement may be permitted on application.

Name	Amount	Application required	Available only to a limited group or single course	See page
AVAILABLE TO STUDENTS ENTERING THE FIRST YEAR				
J. P. Bickell Foundation Scholarships	$600	Yes	No	137
Dominion Magnesium Limited Bursary	$400	Yes	Yes	139
Dominion-Provincial Student Aid Bursaries, Type A	—	Yes	No	139
Engineering Alumni Admission Bursaries	—	Yes	No	140
Engineering Alumni Admission Scholarship	$500	Yes	No	140
Hagarty Memorial Scholarship	$60	Yes	Yes	142
Inco Scholarship	$300 + Fees	Yes	No.	143
The Leonard Foundation Scholarships	—	Yes	Yes	145
J. Edgar McAllister Foundation	—	Yes	Yes	145
O.H.A. War Memorial Scholarship	$200	Yes	Yes	150
Ontario Chapter American Society for Metals Bursary	$400	Yes	Yes	135
A.P.E.O. Admission Scholarship	$500	Yes	No	151
Simpson-Sears Limited (Northern Ontario) Scholarship	$100	Yes	Yes	154
Smith and Stone Limited Bursaries	$150	Yes	Yes	155
Students' Administrative Council Admission Scholarship	$300	Yes	Yes	158
U.T.S. Engineering Scholarship	$250	Yes	Yes	158
Wallberg Admission Scholarships (2)	$500	Yes	No	158

Name	Amount	Application required	Available only to a limited group or single course	See page
AVAILABLE TO STUDENTS COMPLETING THE FIRST YEAR				
American Society for Metals Foundation for Education and Research Scholarship....	$500	No	Yes	135
Atkinson Incourse Bursaries...	—	Yes	No.	135
Babb Bursary Fund..........	—	Yes	Yes	136
Baptie Scholarship............	—	No	Yes	136
Canadian Bechtel Limited Bursaries.................	—	Yes	No	136
J. P. Bickell Foundation Scholarships...............	—	No	No	137
T. H. Bickle Prize............	$30	No	Yes	137
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	139
*John M. Empey Scholarship...	$100	No	No	140
*Hydro-Electric Power Commission Scholarship.........	$300	No	No	143
Inco Scholarship.............	—	Yes	Yes	143
Johnson's Wax Scholarship....	$600	No	Yes	144
Kimberly-Clark Scholarship ...	$500	No	No	144
John Wolfe McColl Awards....	—	Yes	No.	145
Garnet W. McKee-Lachlan Gilchrist Scholarship in Engineering Physics........	$60	No	Yes	146
MacLennan-LacLeod Memorial Prize.................	$25	No	No	147
*Marsland Engineering Ltd. Scholarship................	$250	No	Yes	148
Orenda Engines Scholarship ...	$500	No	Yes	150
*Paulin Memorial Scholarship..	$425	No	Yes	151
Procter and Gamble Bursary..	—	Yes	No	151
*Professional Engineers Scholarship	$250	No	Yes	152
*Ransom Scholarship in Chemical Engineering.......	$150	No	Yes	152
Frederick W. Schumacher Scholarship................	—	Yes	Yes	154
S. Ubukata Fund............	—	Yes	Yes	157
University Alumni Association War Memorial Scholarships .	—	Yes	No	157
University Naval Training Division Bursaries..........	$100	Yes	Yes	157

Name	Amount	Application required	Available only to a limited group or single course	See page
University of Toronto General Bursaries	—	Yes	No	158
*Wallberg Undergraduate Scholarships (2)	$500	No	No	158
AVAILABLE TO STUDENTS COMPLETING THE SECOND YEAR				
*Harvey Aggett Memorial Scholarship	$75	No	No	134
Ardagh Scholarship	$150	No	Yes	135
Automotive Transport Association Bursary	—	Yes	No	136
Babb Bursary Fund	—	Yes	Yes	136
Canadian Bechtel Limited Bursaries	$1200	Yes	No	136
J. P. Bickell Foundation Bursaries	—	Yes	Yes	137
J. P. Bickell Foundation Scholarships	—	No	Yes	137
T. H. Bickle Prize	$30	No	Yes	137
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	139
*John M. Empey Scholarship	$100	No	No	140
J. A. Findlay Scholarship	—	No	Yes	141
Hugh Gall Award	$140	Yes	No	141
*Hydro-Electric Power Commission Scholarship	$300	No	No	143
Johnson's Wax Scholarship	$600	No	Yes	144
Kimberly-Clark Scholarship	$500	No	No	144
The Lever Brothers Scholarships	$300	No	Yes	145
*Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarships	—	No	Yes	146
Charles Gordon Manning Prize	—	No	No	147
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	148
*William R. Worthington Memorial Scholarship	$400	No	Yes	158
W. G. Millar Memorial Scholarship	$250	Yes	Yes	148
James L. Morris Memorial Prize	$125	No	Yes	149
Northern Electric Undergraduate Scholarship	$500	No	Yes	149

Name	Amount	Application required	Available only to a limited group or single course	See page
Orenda Engines Scholarship ...	$500	No	Yes	150
*Spruce Falls Power and Paper Company Scholarships.......	$400	No	No	149
William Storrie Memorial Scholarship	$100	No	Yes	155
*Professional Engineers Scholarship..	$250	No	Yes	152
*Rhodes Scholarship	£400	Yes	No	152
Scottish Rite Masons Bursary .	—	Yes	Yes	154
Frederick W. Schumacher Scholarship	—	Yes	Yes	154
Edith Tyrrell Memorial Bursary..................	$500	Yes	Yes	156
University Alumni Association War Memorial Scholarships .	—	Yes	No	157
University of Toronto General Bursaries.................	—	Yes	No	158
*Wallberg Undergraduate Scholarships..............	$500	No	No	158
AVAILABLE TO STUDENTS COMPLETING THE THIRD YEAR				
Allied Chemical Canada Limited Scholarship........	$850	No	Yes	134
American Institute of Industrial Engineers Scholarship	$100	No	Yes	135
Babb Bursary Fund..........	—	Yes	Yes	136
F. W. Baldwin Prize..........	$75	No	Yes	136
Canadian Bechtel Limited Bursaries.................	—	Yes	No	136
J. P. Bickell Foundation Bursaries.................	—	Yes	Yes	137
T. H. Bickle Prize............	$30	No	Yes	137
*Boiler Inspection and Insurance Company Scholarship.......	$150	No	Yes	138
*California Standard Company Scholarship	$400	No	Yes	138
Chemical Institute of Canada Prize.....................	$25	No	Yes	138
Archie B. Crealock Memorial Prize.....................	$50	No	Yes	138
Dow Chemical of Canada Limited Award............	$500	No	Yes	139

Name	Amount	Application required	Available only to a limited group or single course	See page
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	139
*John M. Empey Scholarship	$100	No	No	140
E.I.C. Prize	$50	No	Yes	141
Engineering Society Semi-Centennial Award	$75	No	No	141
J. A. Findlay Scholarship	—	No	Yes	141
Chester B. Hamilton Scholarship	$500	No	Yes	142
Heating and Air Conditioning Engineers Prize	$75	No	No	143
Hudson Bay Mining and Smelting Company Limited Scholarships	$800	Yes	Yes	143
*Hydro-Electric Power Commission Scholarship	$300	No	No	143
*Jenkins Scholarship in Engineering	$200	No	No	143
Johnson's Wax Scholarship	$600	No	Yes	144
The Lever Brothers Scholarship	$300	No	Yes	145
Loan Funds	—	Yes	No	164
J. A. D. McCurdy Prize	$75	No	Yes	145
Alexander MacLean Scholarship	$250	No	Yes	147
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	148
Mobil Oil of Canada Limited Scholarship	$400	No	Yes	149
Northern Electric Undergraduate Scholarship	$500	No	Yes	149
Orenda Engines Scholarship	$500	No	Yes	150
*Professional Engineers Scholarship	$250	No	Yes	152
Rhodes Scholarship	£400	Yes	No	152
RCE Memorial Scholarship	$125	Yes	Yes	153
Frederick W. Schumacher Scholarship	—	Yes	Yes	154
William Storrie Memorial Scholarship	$100	No	Yes	155
*Spruce Falls Power and Paper Company Scholarships	$400	No	No	149
Edith Tyrrell Memorial Bursary	$500	Yes	Yes	156

Name	Amount	Application required	Available only to a limited group or single course	See page
University Alumni Association War Memorial Scholarships .	—	Yes	No	157
University of Toronto General Bursaries..................	—	Yes	No	158
*Wallberg Undergraduate Scholarships...............	$500	No	No	158
AVAILABLE TO STUDENTS COMPLETING THE FOURTH YEAR				
Henry G. Acres Medal........	—	No	Yes	134
J. P. Bickell Foundation Bursaries..................	—	Yes	Yes	137
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	139
Electrical Manufacturing Co. Limited Prize..............	$25	No	Yes	139
Encyclopaedia Britannica Prize.	—	No	No	140
Hamilton Watch Award.......	—	No	No	143
Heating and Air Conditioning Engineers Prize............	$75	No	No	143
Johnson Foundation Scholarship Award.........	—	Yes	Yes	162
Loan Funds..................	—	Yes	No	166
Massey-Ferguson Ltd. Scholarships (2)............	$500	Yes	Yes	148
Ontario Municipal Electric Association Bursary	$300	Yes	Yes	150
Professional Engineers Gold Medal	—	No	No	152
William Storrie Memorial Scholarship................	$200	No	Yes	155
Society of Chemical Industry Merit Award	—	No	Yes	155
"Second Mile Engineer" Award	$100	No	Yes	154
Trane Company of Canada Limited Prize..............	$200	No	No	156
University of Toronto General Bursaries..................	—	Yes	No	158
AVAILABLE TO GRADUATES				
Aluminium Laboratories Limited Fellowship.........	—	Yes	Yes	159
Athlone Fellowships..........	—	Yes	No	159
C.I.L. Fellowships in Chemistry	$4000	Yes	Yes	159

Name	Amount	Application required	Available only to a limited group or single course	See page
Canadian Lumbermen's Association Timber Research Fellowship	$1250	Yes	No	159
Commonwealth Scholarships	—	Yes	No	160
Consolidated Mining and Smelting Company Fellowship	$1000	Yes	No	160
1851 Exhibition Science Research Scholarships	£275	Yes	Yes	160
Imperial Oil Graduate Research Fellowships	$4000	Yes	Yes	161
International Nickel Graduate Research Fellowships	$2000	Yes	Yes	161
S. C. Johnson Foundation Scholarship Award	—	Yes	Yes	162
McCharles Prize	$1000	No	No	162
The University of Manchester Toronto Fund	£100	Yes	No	163
National Sewer Pipe Limited Scholarship	$500	Yes	Yes	163
Nipissing Mining Research Fellowships	$975	Yes	No	163
H. W. Price Research Fellowship in Electrical Engineering	—	Yes	Yes	163
Raymond Priestley Fellowship	£450	Yes	No	164
Rhodes Scholarship	£400	Yes	No	152
Royal Institution of Great Britain Science Research Scholarships	£350	Yes	No	164
Steel Company of Canada, Ltd., Fellowship	$1500	Yes	Yes	164
Spruce Falls Power and Paper Company Fellowships	$1200	Yes	No	165
1940 Toronto Fund	£500	Yes	No	165
Wallberg Research Fellowships	$6000	Yes	No	165
Charles G. Williams Fellowship	$1500	Yes	Yes	165
Garnet W. McKee Loan and Scholarship Fund	$800	Yes	Yes	165

NOTE—As the value of an endowed scholarship or prize is dependent on the actual income of the fund, it is possible that the value of certain scholarships and prizes at the time of payment may be less than the amount stated in the calendar.

In those cases where the amount of the award is not payable from income earned on an endowed fund, payment will be dependent on the receipt of the amount of the annual award from the donor.

HENRY G. ACRES MEDAL

The Henry G. Acres Medal is the gift of Mrs. Henry G. Acres in memory of her late husband, Henry G. Acres, M.E., D.Sc., a graduate of the School of Practical Science in the class of 1903. Throughout his professional life Dr. Acres was associated with major power developments in Canada and abroad. As chief hydraulic engineer for the Hydro-Electric Power Commission of Ontario in the period 1911 to 1923, he was responsible for the design and construction of nearly twenty power plants, including the Queenston-Chippawa development. Entering private practice in 1924, and until his death in 1945, he continued to widen and extend his interests. He became chief engineer of the Grand River Conservation Commission and responsible for the design and construction of the Shand dam and related work. Later, he was consulting engineer for the extensive power developments at Shipshaw on the Saguenay River, which was vital to the production of aluminum for war purposes. Many of the provinces of Canada sought his services and he advised with respect to work in Newfoundland, South America and India.

This medal is awarded annually to the student in the Fourth Year who is registered in the course in Civil, Mechanical, or Electrical Engineering, and who obtains the highest aggregate percentage at the annual examinations of the Third and Fourth Years, provided always that the student obtains honour standing in the examinations of the Fourth Year. Receipt of the medal does not preclude a student from being granted such other award as may in the opinion of the Council be appropriate.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by the late Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of the annual income from the fund is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance. When regulations do not permit the winner to hold this scholarship the students to be considered for the award shall be the first three in the year exclusive of any student who holds a scholarship of higher value.

ALLIED CHEMICAL CANADA LIMITED SCHOLARSHIP

Allied Chemical Canada Limited has presented a scholarship of the value of tuition fees plus $250.00 to the student and a grant of $250.00 to

the University, to be awarded to a student registered in the Fourth Year of the course in Chemical Engineering who has attained honour standing in the examinations of the Third Year. The recipient must be a Canadian or an American citizen and must not already be receiving other awards exceeding $250.00.

AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS SCHOLARSHIP

The Southern Ontario Chapter, American Institute of Industrial Engineers offers a scholarship of $100.00 to a student entering the Fourth Year of the Industrial Engineering course who has consistently maintained a high academic standing, but not necessarily honour standing, during the previous three years.

AMERICAN SOCIETY FOR METALS FOUNDATION FOR EDUCATION AND RESEARCH SCHOLARSHIP

The American Society for Metals Foundation for Education and Research has donated $500.00 annually since 1953 to provide a Scholarship in the Faculty of Applied Science and Engineering.

The winner must:

(a) obtain the highest average percentage of marks at the examinations of the First Year in Metallurgical Engineering;

(b) register in the Second Year of the course.

This scholarship is not tenable with other awards in the gift of the Senate.

ONTARIO CHAPTER, AMERICAN SOCIETY FOR METALS BURSARY

The Ontario Chapter, American Society for Metals provides a bursary of $400.00 for a student entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than 1st September. The first award will be made for the Session 1958–59.

ARDAGH SCHOLARSHIP

The Ardagh Scholarship, of the annual value of the income from $5,000, has been provided in memory of his parents by Professor E. G. R. Ardagh, B.A.Sc., F.R.S.C., formerly professor of Applied Chemistry in the Faculty. It is awarded to the student who attains the highest standing in Honours at the annual examinations of the Second Year in the Course in Chemical Engineering. The first award was made on the results of the annual examination of 1946.

ATKINSON INCOURSE BURSARIES

Atkinson Incourse Bursaries, gift of the Atkinson Charitable Foundation, are awarded annually to students in the second or higher years of their courses. Applicants must have at least Second Class Honours in the final examinations of the preceding year, demonstrate financial need and be a resident of the Province of Ontario.

Applications must be submitted to the Registrar of the University on or before December 1st.

ATA TRUCKING INDUSTRY EDUCATIONAL FOUNDATION BURSARIES

The Automotive Transport Association of Ontario has established a bursary fund for students in the second or higher years of any undergraduate degree course who find themselves in serious financial need due to sudden, unexpected personal or family difficulties. Applications may be submitted to the University Registrar at any time during the session and the number and value of the bursaries will vary at the discretion of the Committee of Award.

THE BABB BURSARY FUND

Bursaries from this fund are available to students in any year of the Aeronautics Option in Engineering Physics. Application is made through the Secretary of the Faculty.

THE F. W. BALDWIN PRIZE

The F. W. Baldwin Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44), in memory of Frederick Walker "Casey" Baldwin, a graduate of the School of Practical Science, who made a significant contribution in the field of Aeronautics in Canada; and who flew, on March 12th, 1908, near Hammondsport, N.Y., the "Redwing," the first biplane built by the Aerial Experiment Association.

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in the annual examinations of Third Year in "structural subjects."

The first award was made on the results of the examinations of the Session 1953–54.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that a scholarship of one half the annual income shall be awarded annually to an engineering student on the record of the First Year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship, up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the annual examinations of the First Year, enrolled in any one of the courses of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those courses. The first award was made on the results of the annual examinations of the Session 1925–26.

CANADIAN BECHTEL LIMITED BURSARIES

Canadian Bechtel Limited has established Bursaries in the Faculty of Applied Science and Engineering of an annual value of $1,200.00 to

provide not more than four awards, each of a minimum value of $200 and a maximum value of $600. Two awards will be made to First Year students and one or two awards to students registered in any year of the Faculty. Applicants must demonstrate financial need and have academic standing satisfactory to the Faculty Council.

Application must be made to the Secretary of the Faculty on or before October 1st.

J. P. BICKELL FOUNDATION SCHOLARSHIPS

The Trustees of the J. P. Bickell Foundation have established in the Faculty of Arts and the Faculty of Applied Science and Engineering at least seven scholarships for students entering the First Year, of a possible value of Twelve Hundred Dollars each, payable Six Hundred Dollars in the First Year, and provided honours are obtained at the annual examinations, Four Hundred Dollars in the Second Year and Two Hundred Dollars in the Third Year.

An applicant must obtain an average of at least 75% at the Ontario Grade XIII examinations immediately preceding his admission to the University and must undertake to enrol in Mining Engineering, Metallurgy or Applied Geology in the Faculty of Applied Science and Engineering. Failing suitable candidates in the above courses, awards may be made to students enrolled in Honour Science or Mathematics, Physics and Chemistry in the Faculty of Arts and Science. Successful candidates in the Faculty of Arts and Science must enter Geological Sciences or Physics and Geology in the higher years to continue enjoying their awards.

Applications must be submitted to the Registrar of the University not later than May 1.

Ten scholarships are available for the Session 1961–62.

The first awards were made for the Session 1952–53.

J. P. BICKELL FOUNDATION BURSARIES

The Trustees of the J. P. Bickell Foundation have established the J. P. Bickell Foundation Bursaries in the Faculty of Arts and the Faculty of Applied Science and Engineering. An applicant must be enrolled in Honour Science or in Mathematics, Physics and Chemistry in the Faculty of Arts, in which case he must undertake to study mining or geology in his higher years; or be enrolled in a higher year of an honour course in the geological or geophysical field in the Faculty of Arts; or be enrolled in Mining Engineering, Metallurgical Engineering, and Applied Geology in any year of the Faculty of Applied Science and Engineering. He must demonstrate financial need and have satisfactory academic standing.

Application must be made to the Registrar of the University on or before December 1st.

THE T. H. BICKLE PRIZE

The T. H. Bickle Prize is the gift of Mr. and Mrs. E. W. Bickle in memory of their son, T. H. Bickle, an undergraduate of Trinity College and a member of the Senior Intercollegiate Swimming Team at the time

of his death in 1937. The income from the endowment fund will be used to purchase a suitable prize to be awarded annually to a member of the Senior Intercollegiate Swimming Team of this University in any year, faculty or school. The Committee of Award shall consist of the Dean of the Faculty of Arts, the University Registrar, the Director of Athletics, and the Honorary Coach of Swimming. In awarding the Prize the Committee shall consider the character, scholarship, and general interests of the members of the team.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a scholarship in the Course in Mechanical Engineering of the value of One Hundred and Fifty Dollars to the student who obtains highest honour standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Chief Accountant to the fees of the Fourth Year of the successful candidate.

CALIFORNIA STANDARD COMPANY SCHOLARSHIP

The California Standard Company has presented a scholarship of $400.00 to a student who achieves outstanding results in the annual examinations of the Third Year in the Geophysics Option in Engineering Physics or in Applied Geology in the Faculty of Applied Science and Engineering or achieves the highest standing at the annual examinations of the Third Year in Physics and Geology or Geological Sciences in the Faculty of Arts and Science.

The awards alternate annually between the Faculties of Applied Science and Engineering and Arts and Science and the First award will be made in the session 1960–61 in the Faculty of Applied Science and Engineering.

CHEMICAL INSTITUTE OF CANADA PRIZE

The Chemical Institute of Canada offers a prize of the annual value of $25.00 in books to the student registered in the course in Chemical Engineering who, having obtained honours, receives the highest standing in the written and laboratory work of the Third Year.

The first award was made on the results of the final examinations of 1947.

ARCHIE B. CREALOCK MEMORIAL PRIZE

The Archie B. Crealock Memorial Prize is the gift of Mrs. Archie B. Crealock, in memory of her husband, an eminent bridge engineer and a graduate of the Faculty of Applied Science and Engineering of the University of Toronto. It is offered annually to the student of the Third Year in the Course in Civil Engineering, who, having obtained honours in that year, is deemed to be the most worthy of the award. The award is made primarily on the basis of academic standing in the structural subjects of the Year, but extra-curricular activities are also taken into

consideration. The Prize consists of engineering books to the value of Fifty Dollars. The award will not necessarily be made in any year.

DOMINION MAGNESIUM LIMITED BURSARY

Dominion Magnesium Limited provides a bursary of $400.00 for a student entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than 1st September. The first award was made in the Session 1958–59.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "A"

These Bursaries are available to students in financial need who are resident in Ontario, are entering the First Year of University, and have attained an average of at least 66% on eight Grade XIII papers. Application is made not later than June 15th, through the Principal of the secondary school which the student is attending.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "B"

Under this programme, Bursaries may be awarded to students in financial need who are resident in Ontario and who are in attendance at the University of Toronto. To be eligible, students must have obtained not less than sixty-six per cent. at their last annual examination. Further information may be obtained from the Secretary of the Faculty, to whom application must be made by the first week in October.

DOW CHEMICAL OF CANADA LIMITED AWARD

Dow Chemical of Canada Limited have provided funds for an annual award of $500.00 to a student in Chemical Engineering in the Faculty of Applied Science and Engineering, and a grant-in-aid of $250.00 to be used in the winner's department to help defray the cost of equipment, supplies and administration.

The winner must:

(a) be registered in the Third Year in Chemical Engineering (the award will be made in the second term of the Third Year and will be paid to the winner during his Fourth Year)

(b) be in the upper half of the class

(c) have demonstrated leadership in extra-curricular activities.

The award is not tenable with other awards in the gift of the Senate. Application is not required.

THE ELECTRICAL MANUFACTURING COMPANY LIMITED PRIZE

The Electrical Manufacturing Company Limited has established an annual Prize of $25.00 in the Faculty of Applied Science and Engineering.

The winner must:

(a) be registered in the Fourth Year in Electrical Engineering

(b) obtain the highest aggregate percentage of marks at the final

examinations in the subjects of the Fourth Year related to electrical distribution equipment, the subject to be determined by the Head of the Department of Electrical Engineering.

This prize is tenable with other awards in the gift of the Senate.

THE JOHN M. EMPEY SCHOLARSHIPS

The John M. Empey Scholarship Fund was established under a bequest of $10,000 in the Will of the late John Morgan Empey, B.A.Sc., 1903. Three scholarships of equal value are provided from the income from the Fund. One of these scholarships is awarded in each of the First, Second, and Third Years on the results of the annual examinations, to a student who, taking honours, obtains the highest average percentage of marks in the written and laboratory subjects of his Year. The scholarships are open to any students registered in the Faculty. In case the winner of any one of these scholarships does not attend this Faculty during the session next following the award, the right to the scholarship shall be forfeited and the award shall be made to another eligible student. The scholarships were awarded for the first time in 1944.

THE ENCYCLOPAEDIA BRITANNICA PRIZE

Encyclopaedia Britannica of Canada Limited presents a prize consisting of a set of books "Great Books of the Western World" to a student of the Fourth Year in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and has achieved high aggregate marks during his four years in the social-humanistic subjects common to all years.

ENGINEERING ALUMNI ADMISSION BURSARIES

The Engineering Alumni Association has made a number of bursaries with a maximum value of $600 each available annually. Applicants must be residents of Ontario, register in the First Year of the Faculty of Applied Science and Engineering, and need financial assistance.

Applicants should consult their secondary school Principal for details. Further information may be obtained from the Chairman, Engineering Alumni Education Committee, Faculty of Applied Science and Engineering, University of Toronto.

ENGINEERING ALUMNI ADMISSION SCHOLARSHIP

The Engineering Alumni Admission Scholarship, the gift of the Engineering Alumni Association, of the value of $500, is awarded to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a stu-

dent who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Fifty Dollars in this University, commencing 1931, to the student who, in his Third Year in any one of the six courses of Engineering, has proved himself most deserving as disclosed by the examination results of the year, in combination with his activities in the Engineering Society or with a local branch of another recognized engineering organization.

ENGINEERING SOCIETY SEMI-CENTENNIAL AWARD

The Engineering Society Semi-Centennial Award, to the value of Seventy-five Dollars, was established in 1931 to commemorate the semi-centennial of the founding of the "School". The award is made to a student entering the final year.

The selection is based upon the following qualifications, which bear equal weight in the selection of the winner: (*a*) General "School" activities. (*b*) Contributions to the Engineering Society Executive Committee. (*c*) Personality, and social and athletic activities. (*d*) Academic standing.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available, each of a value of one half of the income of the fund, to students in this Course, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession, and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award shall be made to another eligible student.

HUGH GALL AWARD

The Hugh Gall Award, of the annual value of One Hundred and Forty Dollars, the gift of the Graduate Class of 1910, "to commemorate a deceased classmate who was a splendid type of student, a loyal friend, and nationally outstanding in athletic achievement during his undergraduate

career", was established in 1946 for a five year period and, through the generosity of Mrs. Hugh Gall extended for a further three year period. It is awarded to a student, who, having completed his First Year with a general average of at least 66% without conditions, has entered the Second Year, and is in special need of financial assistance in order to enable him to continue his course. It is desirable, but not necessary, that the recipient shall not already have been given any other scholastic award or scholarship applicable to the Second Year and he shall have shown indications of his firm intention and ability to follow successfully the profession of engineering.

Any second year student in the Faculty of Applied Science and Engineering is eligible to apply for this Bursary. Applications should be made to the Secretary of the Faculty not later than one month after the opening of the session.

THE REGINALD AND GALER HAGARTY SCHOLARSHIP

The Reginald and Galer Hagarty Scholarship, in memory of the dearly beloved sons of Lieutenant-Colonel E. W. Hagarty, B.A. 1883, M.A. 1908, and Charlotte Ellen Hagarty, his wife. Reginald Edward Walter Hagarty, B.A.Sc. (Honours) 1908, a graduate of the University in the Faculty of Applied Science and Engineering and at the time of his death on April 29, 1925, a Consulting Structural Engineer. Lieutenant Daniel Galer Hagarty, Princess Patricia's Canadian Light Infantry, a member of the class of 1916 in Applied Science, enlisted for the Great War at the end of his third year in June, 1915, killed in action in Sanctuary Wood, June 2, 1916. The scholarship is given in recognition of the fact that their father was an honour graduate in Classics of the University of Toronto. It is of the value of the annual interest on the capital sum of $2000.00 and is to be awarded to a student who has been enrolled for his Grade XIII Year at Harbord Collegiate Institute and having obtained at least the required standing in each of the Grade XIII subjects necessary for admission to the Faculty, obtains the highest standing in English, a language other than English, and Mathematics, among the students who apply for the award from the Collegiate. He will be required to: (*a*) register in the Faculty of Applied Science and Engineering, (*b*) sign a declaration to the effect that he is willing to take up arms in the defence of Canada and the British Commonwealth should necessity arise as declared by the Parliament of Canada. The Scholarship was offered for award for the first time in 1945. Application should be made to the Registrar of the University.

CHESTER B. HAMILTON SCHOLARSHIP

Members of the family of the late Chester B. Hamilton, a graduate of this Faculty in 1906, have presented a Scholarship in his memory of the annual value of $500.00. It is held by a Fourth Year student in Mechanical Engineering who has achieved outstanding academic standing at the Annual Examinations of the Third Year.

The first award was made on the results of the examinations for the Session 1958–59.

HAMILTON WATCH AWARD

Hamilton Watch Company, Lancaster, Pa. presents a wrist watch, suitably engraved, to the Fourth Year student in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and who has achieved high aggregate marks during his four years in the social-humanistic subjects common to all courses.

HEATING AND AIR CONDITIONING ENGINEERS PRIZE

The Ontario Chapter of the American Society of Heating and Air Conditioning Engineers offers an annual prize of Seventy-five Dollars, first awarded in 1931, for a period of five years, and extended indefinitely in 1935. The prize will be awarded to a student in either the Third or Fourth Year in any Course of the Faculty who, in the opinion of the Department of Mechanical Engineering, has written the most satisfactory thesis on a subject dealing with heating or ventilation, such thesis being prepared under special arrangements made by the Department of Mechanical Engineering, the result to be reported to the Council with the annual examination results. The thesis must be handed in not later than March 1st. The prize will not necessarily be awarded in any year.

Application should be made to the Department of Mechanical Engineering.

HUDSON BAY MINING AND SMELTING COMPANY LIMITED SCHOLARSHIPS

The Hudson Bay Mining and Smelting Company Limited awards Scholarships to students who have obtained their Senior Matriculation at the High Schools in Flin Flon, Manitoba, and its environs. These Scholarships, having a value of $800.00 each annually, may be held in the Third and Fourth Years in this Faculty, in the Course in Chemical Engineering, Metallurgical Engineering, Mining Engineering, and Applied Geology. Application should be made to the Company.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO SCHOLARSHIPS IN ENGINEERING

The Hydro-Electric Power Commission of Ontario has presented three scholarships in Engineering, each of a value of $300.00 to be awarded to three students selected from among the higher ranking students in the annual examinations of the First, Second, and Third Years in any course in the Faculty, one scholarship in each year to be tenable in the Second, Third and Fourth Years respectively.

The first award was made at the annual examinations in April, 1952.

THE INCO SCHOLARSHIP

The International Nickel Co. of Canada Limited has established a Scholarship for students entering the University. Each Scholarship provides for tuition fees plus $300.00 and may be continued throughout a four-year course if satisfactory standing is maintained.

To be eligible for consideration the applicant must obtain an average

of 75% or over in the Ontario Grade XIII subjects required for admission to his course and demonstrate financial need.

Application must be made to the Registrar of the University by May 1st on the regular scholarship application form.

JENKINS SCHOLARSHIP

The Jenkins Scholarship, presented by Jenkins Bros., Limited, Montreal, first awarded in 1925, has been donated to continue indefinitely.

This Annual Scholarship, of the value of Two Hundred Dollars, is awarded to the student of the Third Year registered in any course of the Faculty who has the highest aggregate of percentages for the First, Second, and Third Years.

JOHNSON'S WAX SCHOLARSHIP

S. C. Johnson and Son Limited, Brantford, Ontario, have established a Scholarship of an annual value of $600 in each of the Second, Third and Fourth Years or a total possible value of $1800.

The recipient must:

(*a*) be registered in Chemical Engineering in the years in which the Scholarship is awarded and held;

(*b*) in the opinion of the Council be the most promising and deserving member of the class, obtaining Honours in the final examinations of the First Year;

(*c*) in his Second and Third Years, maintain academic standing satisfactory to the Council, not necessarily Honours, for the continued enjoyment of the Scholarship.

In its discretion the Council may recommend the award of any portion of the Scholarship, lost by the original recipient by failure to maintain satisfactory academic standing, to another student of the year(s) in which the Scholarship would otherwise have been enjoyed.

The first award was made on the results of the annual examinations written in April 1954. It is not tenable with any other Scholarship.

KIMBERLY-CLARK CORPORATION OF CANADA LIMITED SCHOLARSHIPS

Kimberly-Clark Corporation of Canada Limited has presented two scholarships of a value of $500.00 each and each scholarship is accompanied by a grant of $100.00 to the general funds of the University. The Scholarships are awarded on the annual examinations of the First and Second Years and one scholarship is awarded to an outstanding student of the First Year and one to an outstanding student of the Second Year as indicated by the examination results of their respective years. Students in all courses of the First and Second Years are eligible.

The First awards were made on the results of the annual examinations for 1957–58.

THE LEVER BROTHERS SCHOLARSHIPS

Lever Brothers Limited have established two Scholarships of $300.00 each in the Department of Chemical Engineering. The Scholarships will be awarded to a student of the Second Year and to a student of the Third Year in Chemical Engineering to be held in the Third and Fourth

Years respectively. The award is based on outstanding scholarship at the annual examinations.

The first awards were based on the annual examinations of 1957.

THE LEONARD FOUNDATION SCHOLARSHIPS

Leonard Foundation Scholarships are awarded each year to selected students in Universities and Colleges across Canada, including the University of Toronto. The Trust Deed states: "Preference in the selection of students for scholarships shall be given to the sons and daughters respectively of the following: (*a*) clergymen, (*b*) school teachers, (*c*) officers, non-commissioned officers and men, whether active or retired, who have served in His Majesty's military, naval or air forces, (*d*) graduates of the Royal Military College of Canada, (*e*) members of the Engineering Institute of Canada, (*f*) members of the Mining and Metallurgical Institute of Canada."

All applicants must be nominated by a member of the General Committee. The latest date for the receiving of applications is March 31st, for the following academic year. Further information regarding the procedure to be followed in applying for these scholarships may be obtained by writing to Dr. W. E. Taylor, Honorary Secretary, The Leonard Foundation, c/o Toronto General Trusts Corporation, 253 Bay Street, Toronto.

THE J. EDGAR MCALLISTER FOUNDATION

Through the generosity of the late J. Edgar McAllister, a graduate of the Faculty in 1891, a fund has been established in the university to be known as the J. Edgar McAllister Foundation, to provide financial aid for students who require it, in Mining, Mechanical, Chemical, Electrical and Metallurgical Engineering. Inquiries should be made in the Faculty Office.

THE JOHN WOLFE MCCOLL MEMORIAL AWARDS

These six awards, two of which are open to students in the Faculty of Applied Science and Engineering, are the gift of the estate of the late John Wolfe McColl. The awards have a minimum value of $250.00 and a maximum of $750.00. Applicants must have obtained First Class Honours at the final examinations of the preceding year, whether Ontario Grade XIII or at the University of Toronto, demonstrate financial need and be enrolled or undertake to enrol in either Engineering Physics or Chemical Engineering. Students seeking first admission to the University must submit applications for an award to the Registrar of the University on or before May 1st. Students in the University must submit applications for an award to the Registrar of the University on or before October 15th.

THE J. A. D. MCCURDY PRIZE

The J. A. D. McCurdy Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44) in honour of John Alexander Douglas McCurdy, a graduate of the School of Practical

Science, who "made the first flight in Canada on February 23rd, 1909, with a heavier-than-air machine."

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in annual examinations of the Third Year in the subjects related to Aerodynamics.

The first award was made on the results of the examinations of the Session 1953–54.

THE GARNET W. MCKEE-LACHLAN GILCHRIST SCHOLARSHIP IN ENGINEERING PHYSICS

Mrs. Garnet W. McKee and Professor Lachlan Gilchrist each contributed $1000.00 to provide for a Scholarship in the First Year of the Course in Engineering Physics. The value of the Scholarship is the annual income from the capital fund and is awarded to the student who ranks first in honours at the annual examinations of the First Year in the Course in Engineering Physics. If for any reason that student is ineligible to hold the Scholarship, it will be awarded by reversion to the student ranking second in honours in the Course. In order to receive payment the winner must register in the Second Year of the Course in Engineering Physics. The Scholarship was awarded for the first time on the results of the annual examinations of 1947.

THE GARNET W. MCKEE-LACHLAN GILCHRIST GEOPHYSICS SCHOLARSHIPS

Financial assistance was received by Professor Lachlan Gilchrist of the Department of Physics, University of Toronto, from certain organizations and individuals to help him in the prosecution of his research work in Geophysics. With the consent of the contributors, the unexpended balance of these gifts was transferred by Professor Gilchrist to the Board of Governors of the University to be used as an endowment for scholarships, two of which were established in the Faculty of Applied Science and Engineering. To this fund have been added additional amounts received from the estate of the late Garnet W. McKee and from the Hollinger Consolidated Gold Mines Ltd. They are awarded by the Senate, on the recommendation of the Council of the Faculty of Applied Science and Engineering. The first awards were made on the results of the Annual Examinations of 1941.

The First Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $4,000.00, is awarded to the student in the Second Year in the Course of Engineering Physics who obtains the highest aggregate standing at the examinations of the First and Second Years in the Course, provided always that the student obtains honour standing at the examinations of the Second Year.

The Second Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $3,000.00 is awarded to the student in the Second Year in the Course of Engineering Physics who, of those students who elect to proceed in the Third Year in the Geophysics Option of the Course, obtains the highest aggre-

gate standing at the examinations of the First and Second Years, provided always that the student obtains honour standing at the examinations of the Second Year, and excluding always the student to whom the First Lachlan Gilchrist Geophysics Scholarship has been awarded.

If in any year there is no student who has fulfilled the conditions as laid down for the Second Lachlan Gilchrist Geophysics Scholarship, it shall be awarded to the student in the Second Year in the Course in Engineering Physics who obtains the second highest aggregate standing at the examinations of the First and Second Years of that Course, provided always that such student obtains honour standing in the examinations of the Second Year.

THE ALEXANDER MACLEAN SCHOLARSHIP

This scholarship was established by graduates of the University of Toronto and other friends in honour of Professor Alexander MacLean, B.A. (1908) who retired in 1954. The scholarship, of the value of $250, is awarded to a student in the Third Year of Geological Sciences, Faculty of Arts, or in the Third Year of Applied Geology, Faculty of Applied Science and Engineering, who, obtaining not less than 75% in the work of the year, obtains the highest standing in the geological subjects common to the two courses.

The first award was made in 1955.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. If in any year no award is made, a second award will be available in a subsequent year.

CHARLES GORDON MANNING PRIZE

The Charles Gordon Manning Prize was established by a bequest under the Will of the late Jennie Manning in the amount of Five Hundred Dollars ($500), the annual income from which is to be used to buy books for the winner of the Prize.

The recipient must be enrolled in the Second Year of a course offered

by the Faculty of Applied Science and Engineering and, in the opinion of the Council, rank second to the student awarded the Harvey Aggett Memorial Scholarship in the considerations specified for the award of that Scholarship, namely, obtaining honours in his final examinations and being one of the first three in his year by his standing at those examinations relative to the pass requirements in his Department and being "adjudged highest of the three in general student activities and service in the University during his period of attendance."

The first award was made on the results of the Annual Examinations of 1954.

MARSLAND ENGINEERING LIMITED SCHOLARSHIP

The Marsland Engineering Limited Scholarship, the gift of Marsland Engineering Limited, has a value of Two Hundred and Fifty Dollars. It is awarded to the student who, having been granted a Dominion-Provincial Student Aid Bursary in his First Year, is registered in Mechanical or Electrical Engineering and obtains the highest average percentage of marks, with honours, at the annual examination of the First, Second or Third Years in the session in which the award is made.

The first award was made at the annual examinations of 1954.

MASSEY-FERGUSON LIMITED SCHOLARSHIPS

Massey-Ferguson Limited has established two scholarships each of an annual value of $250.00, to be awarded on the recommendation of the Council of the Faculty of Applied Science and Engineering to students registered in the Fourth Year of the Courses in Mechanical Engineering or Industrial Engineering. In making the award academic achievement, financial need, extra-curricular activities and such other factors as may be deemed appropriate will be taken into consideration.

Application should be made to the Secretary of the Faculty not later than 15th October.

THE W. G. MILLAR MEMORIAL SCHOLARSHIP

The W. G. Millar Memorial Scholarship is presented by Marsh and McLennan, Limited, of an annual value of $250.00, in memory of the late Mr. W. G. Millar, a member of the Class of 1914 in Civil Engineering. The Scholarship will be awarded to a student entering the Third Year in Mining Engineering, on the recommendation of the Head of the Department of Mining Engineering.

The award will be made on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

MOBIL OIL OF CANADA, LIMITED, SCHOLARSHIP

Mobil Oil of Canada Limited has donated a scholarship of the annual value of $400.00, tenable in the graduating year of either Geological Sciences, Faculty of Arts or Applied Geology, Faculty of Applied Science and Engineering. The award is based on academic performance in the first three years. Good character, personality, breadth of influence, initiative, willingness to assume responsibility and ability to co-operate with associates may be taken into consideration.

Application is not required.

JAMES L. MORRIS MEMORIAL PRIZE

The James L. Morris Memorial Prize is the gift of Mrs. J. H. Craig and Mr. J. R. Morris, K.C., in memory of their father, James L. Morris, C.E., O.L.S., D.Eng., the first graduate of the School of Practical Science, who died in 1946 after a distinguished career. Graduating in Civil Engineering in 1881 as the sole member of his class, Dr. Morris engaged in railway work for some time, first as an engineer and then as a contractor. For 43 years he conducted a successful civil engineering practice in Pembroke, Ontario, involving important undertakings in the field of municipal, power and bridge work.

This Prize, of the value of the annual income from $3,000.00, is awarded annually to the student in the Second Year in the Course in Civil Engineering who obtains the highest aggregate percentage at the annual examinations of the First and Second Years of the course, provided always that the student obtains honour standing at the Examinations of the Second Year.

SPRUCE FALLS POWER AND PAPER COMPANY LIMITED SCHOLARSHIPS

The Spruce Falls Power and Paper Company Limited has established four Scholarships of a value of $400.00 each, two in the Second Year and two in the Third Year. They are awarded on the results of the Annual Examinations of the Second and Third Years to the students who obtain honour standing at the examinations of their respective years and are open to students in all courses in the Faculty. The first awards were made on the results of the examinations of 1951.

Each scholarship carries a grant of $150 to the University General Funds.

NORTHERN ELECTRIC UNDERGRADUATE SCHOLARSHIP

The Northern Electric Company Limited have established a Scholarship in the Faculty of Applied Science and Engineering and the Faculty of Arts of an annual value of $500.00. In this Faculty the scholar must be registered in the Second or Third Year of Electrical Engineering, Mechanical Engineering, Engineering Physics or Engineering and Business. He must also (a) be a Canadian citizen or landed immigrant and (b) have a minimum of 75% or its equivalent in the previous annual examinations, in this or another recognized University.

The award is made alternately in the two faculties, the first in the Faculty of Arts in 1959 and in the Faculty of Applied Science and Engineering in 1960 and in a similar manner thereafter. Application is not required.

THE ONTARIO HOCKEY ASSOCIATION WAR MEMORIAL SCHOLARSHIP

The Ontario Hockey Association War Memorial Scholarship, the gift of the Ontario Hockey Association, is to be awarded annually at the Grade XIII examination to a man student who has served overseas with the Canadian forces, or to a student who is the son or daughter of one who has so served.

The value of this scholarship is $100 in cash, with an allowance of the same amount on the tuition fee for each session.

In determining the award of the scholarship, the academic qualifications of the candidate shall be first taken into account, provided always that no candidate shall be eligible for an award who has not met all the conditions required by the University of candidates for admission scholarships generally; but, *cæteris paribus*, the award shall be made to a student who is in proved need of assistance.

The award shall be made by the Senate of the University upon the report of a committee to be appointed by the Senate, upon which committee there shall be always one member of the Staff of the University who shall be deemed to be the representative of the Association.

Candidate shall make application not later than May 1st on the special form to be obtained from the Registrar of the University.

ONTARIO MUNICIPAL ELECTRIC ASSOCIATION BURSARY

District No. 4 of the Ontario Municipal Electric Association has provided a Bursary of $300.00 in the Faculty of Applied Science and Engineering.

An applicant for the Bursary must:

(a) be registered in the Four Year, Electrical Engineering
(b) have good academic standing
(c) be in need of financial assistance

Application should be made to the Secretary of the Faculty not later than October 15th.

ORENDA ENGINES SCHOLARSHIPS

Orenda Engines Limited have donated three scholarships each of a value of Five Hundred Dollars, awarded annually to students completing the First, Second and Third Years respectively in courses other than Mining Engineering and Applied Geology. These scholarships are awarded to students with high academic standing and in cases of close competition, preference will be given to the student who indicates that he possesses initiative and leadership qualities and that he will be a credit to his profession after graduation.

This award may be held with other awards provided that the monetary value of the other awards does not exceed One Hundred Dollars. The first award was made in the Session 1955–56.

PAULIN MEMORIAL SCHOLARSHIP

The Paulin Memorial Scholarship, provided through the generosity of the late Mr. Fred W. Paulin, a graduate of the Faculty in 1907, was established in memory of his brother, John Cameron Paulin, a student in Mining Engineering, who was fatally injured in 1906 during a football practice. The Scholarship which has a value of annual income from capital fund of $10,000.00, approx. $400.00, is awarded on the recommendation of the Department of Mining Engineering to a student registered in Mining Engineering, who has successfully completed the work of the First Year.

The award is made on the following bases:

(*a*) academic proficiency.

(*b*) qualities necessary for the development of leadership, such as ambition, initiative, resourcefulness and strength of character.

(*c*) he must continue his studies in Mining Engineering during the following session.

The first award was made for the Session 1951–52.

PROCTER AND GAMBLE BURSARY PLAN

Procter and Gamble Bursaries, the gift of the Procter and Gamble Company of Canada, are awarded annually to students in all years. Applicants must have at least Second Class Honours or better in the final examinations of the preceding year and demonstrate financial need. Applications must be submitted to the Registrar of the University on or before December 1st.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO ADMISSION SCHOLARSHIP

The Association of Professional Engineers of the Province of Ontario has established an Admission Scholarship in Engineering of the value of $500.00, awarded for the Session 1953–54 at Queen's University and for the Session 1954–55 at the University of Toronto and thereafter alternately at each University. It is awarded to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its euivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons

beyond his control. This scholarship is not tenable with any other Admission scholarship.

Successive awards will be made in 1956 and every second year thereafter. Application must be made to the Registrar before May 1st.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO SCHOLARSHIPS

The Association of Professional Engineers of the Province of Ontario offers Scholarships of a value of $250.00 in each of the First, Second and Third Years in the Faculty of Applied Science and Engineering in any course, to the students who, taking Honours, obtain the highest standing in the work of their respective years.

These scholarships will not be awarded to students who hold other scholarships.

PROFESSIONAL ENGINEERS GOLD MEDAL

The Association of Professional Engineers of the Province of Ontario has established in the Faculty of Applied Science and Engineering an award in the form of a gold medal accompanied by a gift of technical books of an approximate value of fifty dollars. The award will be made to the student of the final undergraduate year in any course who, taking honours, obtains the highest weighted average percentage in the practical work and written examinations of the year.

RANSOM SCHOLARSHIP IN CHEMICAL ENGINEERING

The Ransom Scholarship in Chemical Engineering is presented by A. C. Ransom, Esq., of Toronto, for the purpose of encouraging and giving financial assistance to students who choose the field of Chemical Engineering. This donation, consisting of $5,000, provides for a perpetual scholarship of an annual amount such as will be derived from the income of this sum. The first award was made on the results of the annual examinations of 1938.

The scholarship will be awarded annually to the student registered in the Course in Chemical Engineering who obtains the highest aggregate percentage of marks in the examinations of the First Year. The scholarship will be paid to the winner only if he proceeds to take his Second Year in the Course in Chemical Engineering in the University of Toronto.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer for award in the Province of Ontario two out of ten of the Rhodes Scholarships for Canadians, each of the basic value of £400 a year but temporarily increased to £750. They are tenable ordinarily for two years at the University of Oxford. A third year given conditionally at Oxford or elsewhere abroad may be authorized in proper cases.

Each candidate must be a British subject with at least five years domicile in Canada and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year *for* which he is elected; he must have completed the first year and have entered

upon the second year of his course at a Canadian university at the time of application.

A candidate may apply either for the province in which he has his private home or residence, or for the province in which he has taken his university course.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;

(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;

(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;

(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Some definite quality of distinction, whether in intellect, character or personality, or in any combination of these, is the most important requirement. Financial need does not receive special consideration.

Forms of application and full information regarding these scholarships may be obtained from D. R. Michener, Esq., Q.C., 5 Rosedale Road, Toronto 5, General Secretary for the Rhodes Scholarships in Canada or from A. B. Harvey, Esq., Q.C., c/o Law Society of Upper Canada, Osgoode Hall, secretary of the Ontario Selection Committee, or from the University Registrar. Selection is made in December each year for the scholarships for the year following. Application must be made to Mr. Harvey or the appropriate provincial secretary on or before November 1st.

R.C.E. MEMORIAL SCHOLARSHIP

The Memorial Fund Committee of the Royal Canadian Engineers has established the R.C.E. Memorial Scholarship of a value of One Hundred and Twenty-five Dollars, open to students who have successfully completed their second to last year in the Faculty of Applied Science and Engineering or the School of Architecture.

A candidate must be

(a) a member in good standing of the Canadian Officers Training Corps and have successfully completed one summer season's training

or

(b) an ex-member of the Canadian Officers Training Corps who has successfully completed his three years of C.O.T.C. training

or

(c) a member of the Canadian Army (Regular) attending University under the Regular Officers Training Plan.

Selection is made on the basis of academic standing and of qualities of leadership.

Application forms may be obtained at the C.O.T.C. Orderly Room, 119 St. George St.

FREDERICK W. SCHUMACHER SCHOLARSHIP

The Frederick W. Schumacher Scholarship has been established in the Faculty of Applied Science and Engineering and in the Faculty of Arts under a bequest of the late Frederick W. Schumacher. It has a value of the income from the fund. The scholar must (a) be enrolled in the Second, Third or Fourth years in Mining Engineering or Applied Geology in the Faculty of Applied Science and Engineering or in Physics and Geology or Geological Sciences in the Faculty of Arts and (b) must have high academic standing.

Applications must be submitted to the University Registrar not later than October 15th.

THE SCOTTISH RITE MASONS' BURSARY

The Scottish Rite Masons' Bursary, the gift of the Scottish Rite Masons of Toronto, of the value of $300.00 is awarded to a student enrolled in the Second Year who is a member of the Masonic Order, or a son, brother, nephew, daughter, sister or niece of a member of the Masonic Order. Consideration will be given to financial need and academic standing. Evidence of connection with the Masonic Order and information regarding financial need must be given with the application which must be submitted to the Secretary of the Faculty on or before October 15th.

"SECOND MILE ENGINEER" AWARD

Inspired by an address of President William E. Wickenden of Case School of Applied Science, Cleveland, called "The Second Mile", which was based on the text from the Sermon on the Mount, "whosoever shall compel thee to go one mile, go with him twain", the Class of 1935 has established the "Second Mile Engineer" Award. It is the desire of the donors to encourage students to participate in activities outside the confines of their technical training and to interest themselves in the more liberal subjects of the curriculum. The value of the award is $100.00 and is given to a student in his final year.

An eligible group is chosen from those who have taken a prominent part in the affairs of the Faculty, either as office holders or in athletics. In making the award consideration is given to academic standing, with special emphasis on the candidate's attainments in the cultural and humanistic-social studies. The subjects which are stressed are English and Political Science of the First Year; Economics of the Second Year; and Modern World History of the Third Year.

Particulars are furnished each session by the Class of 1935.

THE SIMPSON-SEARS LIMITED (NORTHERN ONTARIO) SCHOLARSHIPS

These scholarships, the gift of Simpson-Sears Limited, are open only to students of the Copper Cliff High School, The Sudbury High and Technical Schools, the Sturgeon Falls High School, the North Bay Collegiate Institute and Vocational School, the Kapuskasing High School and all the Secondary Schools along the Ontario Northland Railway. A scholarship of the value of $100 is available for each of the schools mentioned and an additional sum of $50 will be given to the student

who obtains the highest percentage of the nine papers of Grade XIII selected in accordance with the regulations.

No scholarship will be awarded unless the candidate is in actual attendance in one of the colleges or faculties of the University and maintains a uniformly high standard to the satisfaction of the donors of the scholarships.

Application for these scholarships must be sent not later than May 15th, to the Principal of the North Bay Collegiate Institute and Vocational School, from whom further information may be obtained regarding conditions of award.

SMITH AND STONE LIMITED BURSARIES

Smith and Stone Limited, Georgetown, Ontario, have provided five Bursaries, each of a possible value of $600 and each payable at the rate of $150 per year to assist deserving students from the Georgetown High School.

The award is made annually by the Senate on the recommendation of the Council of the Faculty to a student:

(*a*) who attended Georgetown High School for at least 2 years and is recommended by the Principal;

(*b*) who has met in full the admission requirements of the Faculty, first class honours not being a requirement.

To be eligible for continued enjoyment of the Bursary the holder must maintain satisfactory academic standing but not required to obtain honour standing.

The award was offered for the first time in the Session 1952–53.

SOCIETY OF CHEMICAL INDUSTRY MERIT AWARD

The Society of Chemical Industry Merit Award is made annually by the Society to the student in Fourth Year in the Department of Chemical Engineering who obtains the highest weighted average of marks in the results of the annual examinations for the year. The award is a gold key.

THE WILLIAM STORRIE MEMORIAL SCHOLARSHIPS IN CIVIL ENGINEERING

Three Scholarships have been established by Mrs. William Storrie in memory of her husband, the late William Storrie, a Consulting Engineer on many municipal projects in Canada and for several years a special lecturer in the Faculty of Applied Science and Engineering, for students in Civil Engineering, as follows:

(a) Of a value of $100.00 to the student completing his Second Year in Civil Engineering with the highest aggregate standing in the subjects of Calculus, Engineering Chemistry, Mechanics of Materials, and Surveying.

(b) Of a value of $100.00 to the student completing his Third Year in Civil Engineering with the highest aggregate standing in the subjects of Cements and Concrete, Structural Engineering, Engineering Problems and Drawing, and Hydraulics.

(c) Of a value of $200.00 to the student completing his Fourth

Year in Civil Engineering with the highest aggregate standing in the subjects of Hydraulics, Municipal Administration and Contracts, Sanitary Engineering, and Thesis and Public Speaking.

In all cases the candidates shall have demonstrated qualities of integrity and shown promise of leadership in their profession.

The first awards were made for the Session 1956–57.

STUDENTS' ADMINISTRATIVE COUNCIL ADMISSION SCHOLARSHIP

The Students' Administrative Council Admission Scholarship of the annual value of $300, the gift to a student who (*a*) resides within the District of Manitoulin, or within that part of the Province of Ontario which lies north of the forty-sixth parallel of latitude excluding the cities of North Bay, Sudbury, Sault Ste. Marie, Port Arthur and Fort William; (*b*) obtains the highest average standing in first class honours in the nine papers of Grade XIII prescribed for admission to the course which he desires to enter: and (*c*) who enrols in one of the following faculties: Medicine, Applied Science and Engineering, Forestry, Dentistry, in the School of Architecture, or in the Four-Year Course leading to the degree of Bachelor of Science in Pharmacy.

The scholarship is tenable for two years provided that the holder obtains an average of at least sixty-six per cent. at the annual examinations of the First Year. Application must be made to the University Registrar not later than May 1st.

THE TRANE COMPANY OF CANADA LIMITED PRIZE

The Trane Company of Canada Limited has established an annual Prize of $200.00 in the Faculty of Applied Science and Engineering. The recipient may be registered in the Fourth Year in any course and the Prize will be awarded for the best Thesis on air-conditioning or refrigeration, either for comfort cooling or industrial use.

This award is tenable with other awards in the gift of the Senate. Application is not required.

EDITH TYRRELL MEMORIAL BURSARY

The Women's Association of the Mining Industry of Canada has presented this Bursary, having the value of Five Hundred Dollars, annually, commencing in 1939, and named in memory of their founder and first president, Mrs. Edith Tyrrell. A medal donated by Dr. Tyrrell accompanies the Bursary. The Bursary is awarded to a student entering the Third or Fourth Year in the Course in Mining Engineering, Metallurgical Engineering, or Applied Geology; it may be awarded two years in succession to the same student, but will usually be awarded at the beginning of the Third Year. The award will be made by a special committee appointed by the Association on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

S. UBUKATA FUND

The S. Ubukata Fund for Japanese Students, the gift of the late S. Ubukata, provides for the establishment of scholarships, bursaries, medals, prizes, and loans for students from Japan proper attending the University of Toronto or one of its federated or affiliated colleges. An applicant for a scholarship, bursary or loan must be in good standing and have completed the first year of the work of the faculty or department in which he is registered. An occasional student must obtain a certificate from the head of the college or dean of the faculty concerned that full time is being devoted to his or her studies. A student is not eligible who is at the time in receipt of aid or support from any other institution, religious or otherwise, in this country or in Japan or who already holds a scholarship or fellowship in the University. Application must be made to the University Registrar on or before December 1st.

UNIVERSITY OF TORONTO ALUMNI ASSOCIATION WAR MEMORIAL SCHOLARSHIPS OR AWARDS

Six scholarships and awards, each of the value of $200.00 will be granted in 1960–61 by the Alumni Association from the War Memorial Scholarship Fund to students registered in the Faculty of Applied Science and Engineering.

The general basis on which scholarships or awards may be granted will be as follows: (*a*) standing in course of studies; (*b*) relationship to active service in the armed forces of Canada; (*c*) need of financial assistance; (*d*) merit shown by participation and interest in extra-curricular undergraduate activities of the University; (*e*) such other qualifications as may commend themselves to the Alumni Association.

Information regarding these scholarships and awards may be obtained from The University of Toronto Alumni Association, 18 Willcocks Street, to whom application must be made before March 1st.

UNIVERSITY NAVAL TRAINING DIVISION BURSARIES

The University Naval Training Division Bursaries, the gift of the University Naval Training Division, are of the value of $100 each. As many as three bursaries may be awarded in each session; if fewer than three are awarded those not awarded may be given in a subsequent session. A candidate must be registered in the University for a full-time course leading to a diploma or degree and must be at the time of the award a member of one of the recognized military training units within the University. Application must be made to the University Registrar before the end of November.

UNIVERSITY OF TORONTO GENERAL BURSARIES

The Board of Governors has established a fund to provide bursaries for deserving students who without financial assistance cannot continue their formal education. Further information may be obtained from the Secretary of the Faculty.

THE U.T.S. ENGINEERING SCHOLARSHIP

The U.T.S. Engineering Scholarship, the gift of R. A. Bryce, Esq., of the value of $250. The scholarship will be awarded by a committee of the Staff of the University of Toronto Schools to a student of the Schools who has completed the requirements for admission to and enrols in the Faculty of Applied Science and Engineering.

WALLBERG ADMISSION SCHOLARSHIPS

Two admission scholarships, each of a value of $500.00 are awarded annually from the income from the Wallberg Bequest on the recommendation of the Council of the Faculty to the two candidates who obtain the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that this attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Applications must be submitted to the Registrar on the prescribed form by May 1st.

WALLBERG UNDERGRADUATE SCHOLARSHIPS

These scholarships, four in number, of the value of $500.00 each, derived from the Wallberg Bequest, are awarded annually; two to students ranking first and second respectively at the annual examinations of the First Year; one to the student ranking first at the annual examinations of the Second Year; and one to the student ranking first at the annual examinations of the Third Year.

Any holder of one of these scholarships may not hold other awards listed in the Calendar with an asterisk. The awards were first made on the result of the annual examination of 1947.

WILLIAM R. WORTHINGTON MEMORIAL SCHOLARSHIP

The William R. Worthington Memorial Scholarship, the gift of Miss Ida R. Worthington, in memory of her brother, William R. Worthington, Dip.(1904), B.A.Sc.(1905), of the value of the income from a fund is awarded annually to the student of the Second Year in the course in

Civil Enginering who ranks highest at the anual examinations of that year.

The first award was made at the examinations for the Session 1954–55.

ALUMINIUM LABORATORIES LIMITED FELLOWSHIP

The Aluminium Laboratories Ltd. have established a fellowship valued at $1100 or $1800 (8- or 11-month tenure) plus fees. This award will be held in the School of Graduate Studies by a candidate for a Master's or a Doctor's degree in the fields of mathematic or physical sciences, pure or applied, preference being given to students in the field of physical metallurgy.

THE ATHLONE FELLOWSHIPS

Her Majesty's Government in the United Kingdom has established a number of fellowships to be awarded annually to enable Canadian engineering graduates to take postgraduate training in the United Kingdom. These became available in 1951 when five fellowships were open to graduates of the University of Toronto immediately after graduation. Additional fellowships are for award to graduates who have already spent some time in industry. The fellowships cover costs of transport, fees and maintenance and are normally tenable for a period of two years. They may be utilized for (*a*) works training in industry, (*b*) postgraduate university study, or (*c*) a combination of these. Candidates must be Canadian citizens or British subjects normally resident in Canada and should preferably be less than 27 years of age. Further information and application forms may be obtained from the Secretary of the Faculty.

THE C.I.L. FELLOWSHIPS

Two Fellowships, the gift of Canadian Industries (1954) Limited, of the value of $2,000 each are established for the encouragement of postgraduate work in Chemistry. An applicant must be a university graduate who is a Canadian citizen or a graduate who intends to follow a career in Canada, with preference to Canadian citizens. The holders of these Fellowships will be required to undertake research in any branch of Chemistry under the direction of the department designated by the Committee of Award. Application must be made, with full statement of qualifications and testimonials, to the Secretary of the School of Graduate Studies not later than March 1st.

CANADIAN LUMBERMEN'S ASSOCIATION TIMBER RESEARCH FELLOWSHIP

This fellowship, donated by the Canadian Lumbermen's Association, is offered to encourage advanced study and research in timber engineering. It is open to graduates in engineering and graduates in forestry of any recognized university. The fellow must be registered in the School of Graduate Studies as a student proceeding to a post-graduate degree and must carry out a prescribed programme of study and research in both engineering and forestry. It is intended that the work of this programme will extend over a period of two academic years. The annual value of the fellowship is $1,250, all of which might not be granted to one student.

Application should be made to the Secretary of the School of Graduate Studies not later than September 1st and should be accompanied by an official transcript of the applicant's undergraduate record, together with a statement of his experience in the forestry and construction fields.

CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA, LIMITED, RESEARCH FELLOWSHIP

The Consolidated Mining and Smelting Company of Canada, Limited, offers annually a Research Fellowship in the School of Graduate Studies of $1,000 for a research in some field of pure or applied science; an additional amount of $500 is available for special equipment and supplies. The Fellowship is known as the "Cominco Research Fellowship."

It is open to graduates in Science, Engineering, or Agriculture of a recognized university and preferably a British subject resident in Canada.

Applications for the Fellowship must be made to the Secretary of the School of Graduate Studies, not later than September 1st.

COMMONWEALTH SCHOLARSHIPS

Under a Plan drawn up at a conference held in Oxford in 1959, each participating country of the Commonwealth offers a number of scholarships to students of other Commonwealth countries. These scholarships are mainly for graduate study and are tenable in the country making the offer. Awards are normally for two years and cover travelling, tuition fees, other university fees, and a living allowance.

For details of the awards offered by the various countries consult the Registrar's Office, or write to The Canadian Universities Foundation, 77 Metcalfe Street, Ottawa.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIPS

The Royal Commissioners for the Exhibition of 1851 have invited the University of Toronto to recommend annually one or more candidates in order of merit for science research scholarships, each of the value of £350 per annum and ordinarily tenable for two years. The Commissioners may make a supplementary grant up to £50 per annum for University fees, etc., payable by the scholar during his tenure of the award.

Each candidate recommended must be a British subject, and under twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in

some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University, the students of which are eligible to apply for these scholarships: 1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geological Sciences; 13. Physics; 14. Physiology; 15. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the university, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board is appointed by the Senate and has power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than March 1st to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

IMPERIAL OIL GRADUATE RESEARCH FELLOWSHIPS

Imperial Oil Limited in 1946 established for annual competition Graduate Research Fellowships, now five in number and having a potential value of $4,800 each ($1,600 a year for a maximum of three years). Each fellowship may be supplemented by an annual amount of $900 if the fellow continues his thesis work during the summer months. A fellow may not hold concurrently other awards which annually equal or exceed the value of the regular Imperial Oil payments ($1,600).

The fellowships are open to any graduate of any approved Canadian university and are offered for research leading to a Doctor's degree in the fields of Chemistry, Physics and/or Engineering (2 fellowships), Geology (1 fellowship), Economics, Psychology, Sociology, or Business Administration (1 fellowship) and Humanities such as English, Ancient and Modern Languages, History, or Philosophy (1 fellowship). Nomination of students for the fellowships is made by the university—such nominations to be received by the Secretary, Imperial Oil Scholarship Committee, Imperial Oil Limited, 111 St. Clair Avenue West, Toronto 7, not later than March 1st of each year.

THE INTERNATIONAL NICKEL GRADUATE RESEARCH FELLOWSHIPS

The International Nickel Company of Canada has established a number of Graduate Research Fellowships, to promote and encourage research in the technical fields serving the Canadian metal industries and to further public interest in industrial science in Canada. Each has a possible tenure of three years with an annual payment of $2,500, of which

$2,000 is payable to the fellow and $500 is placed at the disposal of the directing professor for necessary materials or equipment. It is expected that four new fellowships will be awarded in 1961.

Applications on behalf of competent graduate students will be considered from any Canadian university qualified to confer the Master's or Doctor's degree in Geology (including Geophysics), Mining, Ore Dressing, Metallurgy (both process and physical), Chemistry (pertaining to metals), Physics (pertaining to metals), and Mathematics. Awards are made by a committee appointed by the National Conference of Canadian Universities and Colleges.

Application should be made to the International Nickel Company of Canada, Limited, 55 Yonge Street, Toronto 1, Ontario, not later than February 14.

THE JOHNSON FOUNDATION SCHOLARSHIP AWARD

The Johnson Foundation through S. C. Johnson and Son Limited, Brantford, Ontario, offers one scholarship each year for study in a United States College or University in postgraduate fields of study such as economics, business administration, chemistry, engineering, teaching, etc. The amount of the scholarship varies according to the requirements of each student.

Further information may be obtained from S. C. Johnson and Son Limited, Brantford, Ontario, and preliminary application must be received by them not later than December 15th.

MCCHARLES PRIZE

This prize, the gift of the late Æneas McCharles of the value of $1,000, is awarded from time to time but not necessarily every year on the following terms and conditions: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions determine the method of award.

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000) in money.

(3) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(4) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE UNIVERSITY OF MANCHESTER TORONTO FUND

The University of Manchester has accepted the gift of a sum of £1,699 from a Committee representing the parents of children who during the war were evacuated to Toronto and other places in Canada. The capital and any income arising therefrom will be used to make grants to Canadians wishing to conduct post-graduate studies and/or research in the University of Manchester, preference being given to students who have graduated from the University of Toronto. The total amount of grant or grants to any student will not exceed £100. Applications must be submitted to the Registrar of the University of Toronto on or before January 1st of the year in which the applicant wishes to enter the University of Manchester, together with transcripts of undergraduate and graduate record and outlines of the post-graduate studies and/or research to be followed at the University of Manchester.

NATIONAL SEWER PIPE COMPANY LIMITED SCHOLARSHIP

The National Sewer Pipe Company Limited has established a scholarship of a value of Five Hundred Dollars ($500.00) in the School of Graduate Studies. It is awarded annually to a student who undertakes to enroll in that School, proceeding to the degree of Master of Applied Science in the graduate Department of Civil Engineering and in the course in Public Health Engineering.

Applications must be submitted to the Secretary of the School of Graduate Studies on or before March 1st.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering, to be known as The Nipissing Mining Company Research Fellowship, of the annual value of the income from the fund, plus free tuition.

This Fellowship is open to graduates of any University.

H. W. PRICE RESEARCH FELLOWSHIP IN ELECTRICAL ENGINEERING

The H. W. Price Research Fellowship in Electrical Engineering consisting of the income or a part thereof but not exceeding the income for three years derived from the sum of $10,000 donated by the Hydro Electric Power Commission of Ontario, will be awarded from time to time as recommended by the School of Engineering Research, to a graduate in Electrical Engineering of any recognized University, registered in the School of Graduate Studies, wishing to proceed with an investigation in the field of Electrical Engineering.

Forms of application may be obtained from the Secretary, School of Graduate Studies, and should be returned with a statement of qualifications not later than March 1st. The first award was available in 1943.

THE RAYMOND PRIESTLEY FELLOWSHIP

The University of Birmingham being "anxious to mark its indebtedness and its gratitude" for the hospitality shown during the Second World War to children of members of its teaching staff by members of the University of Toronto, has set aside a research fellowship to be held by a graduate of the University of Toronto. This fellowship, to be known as the Raymond Priestley Fellowship, of the value of £450 per annum as well as the cost of the return passage from Canada, is available for graduates, both men and women, preferably those who have already shown some capacity for and interest in research. The fellowship will normally be awarded for a period of three years. It is tenable in any faculty of the University of Birmingham. The Fellow will undertake research and may, if he wishes, be a candidate for a higher degree at the University of Birmingham. The selection of the candidate will be made by the University of Toronto. The process of selection will include negotiation with the head of the department concerned in the University of Birmingham to ensure that there is in the University opportunity for the pursuit of the particular line of research required. Applications must be submitted to the University Registrar not later than March 1st, together with transcripts of undergraduate and graduate records and outlines of the research to be undertaken at the University of Birmingham.

THE ROYAL INSTITUTION OF GREAT BRITAIN SCIENCE RESEARCH SCHOLARSHIPS

A scholarship of the value of £350 per annum with a possible additional allowance of £50, to be held ordinarily for a period of two years, will be offered each year to a candidate from one of the universities of Canada, Australia, New Zealand and South Africa, and is tenable only in the Davy Faraday Research Laboratory of the Royal Institution, London. No candidates will be considered except those who have been recommended for the 1851 Exhibition Science Research scholarships, and candidates who wish to be considered also for the Royal Institution scholarships are requested to state this clearly in the application for an 1851 scholarship. No other application to the Royal Institution is necessary. Copies of the regulations relating to these scholarships may be obtained from the University Registrar.

THE STEEL COMPANY OF CANADA LIMITED FELLOWSHIPS IN METALLURGY

Four Fellowships, each of the value of $3,000, out of which $2,000 will be awarded to the successful candidate and $1,000 to the university at which he or she studies, are offered to permanent residents of Canada who are graduates of a Canadian university. The fellowships are normally tenable for one year but in special circumstances may be renewed for a second year. Applications must be made in triplicate on the approved form to The Secretary, Canadian Universities Foundation, 77 Metcalfe Street, Ottawa. Forms may be obtained from the relevant department in your university, from the Registrar's office, or from the above address.

SPRUCE FALLS POWER AND PAPER COMPANY, LIMITED, FELLOWSHIP

The Spruce Falls Power and Paper Company Limited has established a Fellowship for the encouragement of research in the Faculty, of an annual value of $1200. It is open to graduates of the University of Toronto or of other recognized universities, but is restricted to Canadian Citizens. Application should be sent to the Secretary of the School of Graduate Studies, not later than March 1st.

The Fellowship also carries a grant of $300 to be applied to the tuition of the holder and $300 to the general University Funds.

THE 1940 TORONTO FUND

The 1940 Toronto Fund, the gift of Oxford University, of the value of £3000, was set up in 1940 by the parents of Oxford children who were taken into Canadian and American homes during the War. Recommendations for grants from the Fund will be made from time to time by the Senate of the University of Toronto to members of the University "who wish to go to Great Britain for the purpose of study, research, or any general educational purpose, taking education in the widest possible sense." Each applicant for a grant from this Fund must submit his application to the University Registrar not later than March 1st together with an outline of the study or research which he proposes to undertake in Great Britain, or the general educational purpose which he has in mind in going there.

WALLBERG RESEARCH FELLOWSHIPS

Three Wallberg Research Fellowships of the value of $2,000 each are open to graduates of any recognized university who propose to pursue advanced study and research in any branch of Engineering in the University of Toronto.

Forms of application may be obtained from the Secretary of the School of Graduate Studies. These should be returned together with a transcript of academic record and an outline of the proposed study and research not later than March 1st.

THE CHARLES G. WILLIAMS FELLOWSHIP IN URANIUM METALLURGY

Eldorado Mining and Refining Limited offers a postgraduate scholarship in Uranium Metallurgy to a graduate in the physical sciences, pure and applied of a value of $1,500 for an academic year and the holder is also eligible for a supplementary amount of $800 for the summer months. A cash grant to the University accompanies the fellowship.

Application forms may be obtained from the Registrar of the University and submitted to the Secretary, Eldorado Mining and Refining Limited, P.O. Box 379, Ottawa, Ontario, before 15th March.

GARNET W. MCKEE LOAN AND SCHOLARSHIP FUND

The late Mrs. Garnet W. McKee has given this fund to assist students of promise at the University of Toronto, and to develop and extend

by research the following subjects studied in the Engineering Physics course in the Faculty of Applied Science and Engineering, especially in their application to the industries of Canada: Electricity and Communications; X-rays and Spectroscopy; Illumination and Acoustics; Geophysics; Refrigeration; Aeronautics.

In each session $800 from the annual income of the fund will be allotted to provide the Garnet W. McKee Scholarship, tenable preferably by a graduate who was eligible for a loan in a previous session, or who is in at least the second year of his graduate work.

Each holder of the said Scholarship and each graduate to whom a loan is granted will be required in the following session to enrol in the School of Graduate Studies and to pursue studies leading to a graduate degree in one or more of the subjects listed, and he may not engage in remunerative employment during the session except by permission of the Committee of Award.

Applications for a loan must be made to the Secretary of the School of Graduate Studies not later than September 1st.

Applications for a Scholarship must be accompanied by an outline of the proposed research problem.

LOAN FUNDS

From the loan funds mentioned below, small loans can be made to students who are in urgent need of assistance. The funds are not large and the loans must accordingly be restricted, both in amount and number, and principally to students in the Third and Fourth Years.

Enquiries for loans from any of the following funds should be made at the office of the Secretary of the Faculty.

Engineering Alumni Loan Fund
Engineering Society Loan Fund
Elizabeth Speller Memorial Fund
James W. Crocker Memorial Fund
Harry F. Bennett Educational Fund
S.A.E.—Canadian Section Loan Fund
Class of 2T7 (SPS) Memorial Loan Fund
Avro Aircraft Limited Engineering Loan Fund
Association of Professional Engineers Loan Fund
The William Storrie Memorial Fund
3T6 Engineers Loan Association
4T0 Engineering Loan Fund
Women's Association of the Mining Industry in Canada Loan Fund
The Devonshire Loan Fund
Class of '09 Trust Fund

CLASS OF 1936 LOAN ASSOCIATION

Members of the Class of 1936 have made arrangements to assist students in obtaining loans through regular banking facilities. Information may be obtained from the Secretary of the Faculty.

ENGINEERING ALUMNI LOAN FUND

The Engineering Alumni Association established in 1950 a loan fund to assist engineering students, especially in the Third and Fourth Years.

Applications for loans from this fund should be made to the Secretary of the Faculty.

CLASS OF 2T7 (SPS) MEMORIAL LOAN FUND

This fund was established in 1955 to memorialize the Class of 1927 of the Faculty of Applied Science and Engineering.

Loans to a total of $250 are available to any undergraduate who has completed one Year, with or without conditions, and who has qualified for the Second, Third or Fourth Year.

Application shall be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary of the Faculty.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller, of the Class of 1893, the "Elizabeth Speller Memorial Fund" has been established to provide loans for worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

JAMES W. CROCKER MEMORIAL LOAN FUND

This fund was established by Mrs. William Crocker in memory of her son, James W. Crocker, a graduate in Mining Engineering in 1938, who was killed in an accident in a mine in the same year.

HARRY F. BENNETT EDUCATIONAL FUND

This fund was established by subscription from members of The Engineering Institute of Canada in memory of the late Harry F. Bennett, M.E.I.C., who for six years prior to his death in 1946 was chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, and who accomplished so much in this field by untiring efforts.

One purpose of the fund is to make loans to deserving students who need financial assistance to enable them to study engineering sciences at university level, and who have proved themselves by successfully completing their first year in engineering or the equivalent.

Loans will be made largely on the basis of character and to men who seem likely to develop the high professional standards which are essential to leadership in engineering science. A student who has been aided by this fund should feel that high obligations are placed on him; obligations to the subscribers, to the trustees, and to those coming after him who in turn can receive help as his loan is repaid.

Application forms may be obtained at the Faculty Office. The regulations are simple and the application of any worth-while student will be given immediate and careful attention.

SOCIETY OF AUTOMOTIVE ENGINEERS—CANADIAN SECTION LOAN FUND

The Society of Automotive Engineers—Canadian Section has established a loan fund of $1,200.00 in the Faculty of Applied Science and Engineering. Preference is given to students in good scholastic standing and engaged in studies relative to the automotive and aircraft industries, and to students in fourth, third and second years in that order. Particulars may be obtained from the Secretary of the Faculty.

AVRO AIRCRAFT LIMITED ENGINEERING LOAN FUND

Avro Aircraft Limited has established a Loan Fund of $3,000.00 to provide loans to engineering students requiring financial assistance. Application should be made to the Secretary of the Faculty.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO LOAN FUND

The Association of Professional Engineers has made loans not exceeding $200 available to students in the First, Second and Third Years in this Faculty. Application should be made to the Association at 236 Avenue Road, Toronto.

THE WILLIAM STORRIE MEMORIAL FUND

The William Storrie Memorial Fund has been established by Mrs. William Storrie to provide loans to undergraduates in the course in Civil Engineering. Application should be made to the Secretary of the Faculty.

THE DEVONSHIRE LOAN FUND

This Fund has been established by Graduates and friends of Devonshire House to assist students in the Residence. Application should be made to the Office of the Dean of Devonshire House.

CLASS OF '09 TRUST FUND

The Class of '09 on the 50th Anniversary of their graduation made a sum of money available in the Faculty for financial aid to undergraduates, with preference to Second Year students. Inquiry should be made to the Secretary of the Faculty.

SECTION XI. DISCIPLINE

1. Subject to the general regulations of the Caput of the University regarding jurisdiction in matters of discipline the Council of University College, the governing bodies of the Federated Universities and Affiliated Colleges, and the Councils of the Faculties, Schools, and Institutes have disciplinary jurisdiction over the conduct of all students registered in these Divisions of the University in all matters of local or internal concern to these Divisions. Jurisdiction over the conduct of students while in residence regardless of the Division of the University in which they are registered is vested in the body administering the residence.

2. Jurisdiction concerning conduct likely to affect the interests of the University as a whole is vested in the Caput.

3. The Students' Administrative Council will be supported in the proper performance of all its obligations and duties as provided in its Constitution.

4. Where the appropriate body exercising disciplinary jurisdiction has found that a student of the University has engaged in conduct prejudicial to the interests of the University, the Caput may, in its discretion, suspend or expel such student from the academic privileges of the University. In every case where the Caput imposes a penalty of suspension or expulsion from the University, an appeal lies to the Board of Governors.

5. Any student who interferes with the personal liberty of another or who subjects another student to indignity or personal violence may be considered by the Caput or any other body exercising disciplinary jurisdiction in the University to have committed a breach of discipline.

6. Initiation ceremonies involving physical violence, personal indignity, interference with personal liberty, or destruction of property, may be deemed a breach of discipline by the Caput or any other body exercising disciplinary jurisdiction in the University.

7. Without limiting the disciplinary powers vested in the respective bodies exercising disciplinary jurisdiction as set forth in sections 1–7, the following are cited as illustrations of conduct which, in the past, has been considered a breach of discipline prejudicial to the interests of the University:

- (i) The organising of a parade on the streets of the city or the taking part in such a parade without permission of the authorities.
- (ii) The destruction or defacing of University property, raids on Residences or other University buildings, and the breaking into University buildings.
- (iii) Rowdy and other forms of behaviour, either on or off the Campus, of such an objectionable nature as to bring the University into public disrepute.

8. Student Clubs and Associations

(a) The constitution of every society or association of students in the University and all amendments to such constitutions require to be approved by the relevant University authorities. The giving of approval, and the responsibility for the programmes of student societies and associations, shall rest as follows:

(i) With the authorities of the College, Faculty or School concerned where the membership of the student society or association is drawn from a single College, Faculty or School.

(ii) With the Board of Stewards of Hart House, where the student society or association is a Committee of Hart House and is controlled by the Board of Stewards of Hart House.

(iii) With the Caput, in the case of all other student societies and associations.

(b) No approval will be given by any of the authorities listed in (a) above to the constitution of any society or association of students if that constitution permits:

(i) Membership in the society or association to persons who are not students of the University, unless in the case of the societies listed in (a) (ii) above, where membership is open also to graduates of the University and members of the Faculty of the University.

(ii) Any action of discrimination based upon race, religion, or colour.

9. The name of the University is not to be used in connection with a publication of any kind without permission of the Caput.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1959–60

Year	1	2	3	4	5	6	7	8	9	Total
I	63	5	55	20	86	82	76	11	10	408
II	62	4	74	25	85	66	88	12	8	424
III	56	10	67	38	92	54	70	10	11	408
IV	90	15	83	26	79	50	81	15	13	452
Total	271	34	279	109	342	252	315	48	42	1692
Special Students										6
										1698

INDEX

UNIVERSITY OF TORONTO

CALENDAR

Faculty of Applied Science and Engineering

1962-1963

UNIVERSITY OF TORONTO PRESS
1962

CALENDAR 1962

Jan.

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CONTENTS

SECTION 1. CALENDAR 1962–63

FALL TERM, 1962

July 2	*Monday*	Buildings closed.
July 9	*Monday*	Last day for receiving applications for supplemental examinations.
August 6	*Monday*	Civic Holiday, Buildings closed.
August 7	*Tuesday*	Supplemental Examinations commence.
August 13	*Monday*	Students of the III Year, Course 1, report at Survey Camp.
August 20	*Monday*	Students of the III Year, Course 2, and 9, report at Survey Camp.
September 3	*Monday*	Labour Day. Buildings closed.
September 4	*Tuesday*	Students in IV Year, Course 1, Group B, report at Survey Camp.
September 5	*Wednesday*	Students in II Year, Course 6, report for Analytical Chemistry Laboratory.
September 6	*Thursday*	Special Meeting of Faculty Council.
September 13 September 14	*Thursday* *Friday*	Registration in person of the I Year from 9:30 a.m. to 12:00 noon and from 2:00 p.m. to 4:30 p.m. at 119 St. George Street.
September 17	*Monday*	Registration in person of the II and III Years from 9:30 a.m. to 12:00 noon and from 2:00 p.m. to 4:30 p.m. in the Galbraith Building.
		Dean's address to the I Year.
		Preliminary instruction to the I Year.
September 18	*Tuesday*	Registration in person of the IV Year from 9:30 a.m. to 12:00 noon, and 2:00 p.m. to 4:30 p.m. in the Galbraith Building.
		Meeting of Faculty Council.
September 19	*Wednesday*	Lectures and Laboratory work commence at 9:00 a.m.
		Opening address by the President to the students of all Faculties at 3:45 p.m. in Convocation Hall. Lectures and Laboratory classes withdrawn from 3:00 p.m.
October 3	*Wednesday*	Meeting of Faculty Council.
October 8	*Monday*	Thanksgiving Day. Buildings closed.
October 12	*Friday*	Meeting of Senate.

November 1	*Thursday*	Meeting of Faculty Council.
November 9	*Friday*	Meeting of Senate.
November 10	*Saturday*	Remembrance Day Service 10:45 a.m. Lectures and Laboratory classes withdrawn from 10:00 a.m. to 12 noon.
November 23	*Friday*	Fall Convocation.
December 3	*Monday*	Meeting of Faculty Council.
December 14	*Friday*	Meeting of Senate.
December 18	*Tuesday*	First Year Term Examinations.
December 19	*Wednesday*	First Year Term Examinations. Term ends at 5:00 p.m.
December 25	*Tuesday*	Christmas Day.

SPRING TERM, 1963

January 1	*Tuesday*	New Year's Day.
January 2	*Wednesday*	Spring term begins. Mid-session Examinations commence.
January 8	*Tuesday*	Meeting of Faculty Council.
January 11	*Friday*	Meeting of Senate.
January 15	*Tuesday*	Last day for receiving the second term instalment of fees.
January 17	*Thursday*	IV Year Employment interviews.
January 18	*Friday*	IV Year Employment interviews.
January 19	*Saturday*	IV Year Employment interviews.
February 4	*Monday*	Meeting of Faculty Council.
February 8	*Friday*	Meeting of Senate.
March 1	*Friday*	Meeting of Faculty Council.
March 8	*Friday*	Meeting of Senate.
April 3	*Wednesday*	Meeting of Faculty Council.
April 5	*Friday*	Term ends at 5:00 p.m.
April 11	*Thursday*	Meeting of Senate.
April 12	*Friday*	Good Friday, Buildings closed.
April 13	*Saturday*	Buildings closed.
April 15	*Monday*	Annual Examinations commence.
May 2	*Thursday*	Meeting of Faculty Council.
May 10	*Friday*	Meeting of Senate.
May 20	*Monday*	Victoria Day. Buildings closed.
May 27	*Monday*	University Commencement.
May 28	*Tuesday*	University Commencement.
May 29	*Wednesday*	University Commencement.
May 30	*Thursday*	University Commencement.
May 31	*Friday*	University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

1961–62

THE UNIVERSITY

President . . . . C. T. Bissell, M.A., PH.D., D.LITT., LL.D., F.R.S.C.

Executive Assistant to the President . . . . J. H. Sword, M.A.
Registrar . . . . R. Ross, M.B.E., M.A.
Chief Librarian . . . . R. H. Blackburn, M.A., B.L.S., M.S.
Director of University Extension . . . D. C. Williams, M.A., PH.D.
Chairman of the Medical Sciences Advisory Council
J. A. MacFarlane, O.B.E., E.D., B.A., M.B., LL.D., F.R.C.S.

Vice-President (Administration) . . . . F. R. Stone, B.COM., F.C.A.
Comptroller . . . . G. L. Court, D.F.C., M.COM., C.A.
Secretary of the Board of Governors . . . . J. F. Brook
Superintendent of Buildings and Grounds . F. J. Hastie, B.SC., P.ENG.
Chief Accountant . . . . D. J. Reid

Director of the University of Toronto Press . . . M. Jeanneret, B.A.

Director of Alumni Affairs . . . . J. C. Evans, B.A.
Director of Information . . . . K. S. Edey
Director of Development . . . . R. J. Albrant
Director of Graduate Records . . . . . C. G. M. Grier, E.D., M.A.

Warden of Hart House . . . . J. McCulley, M.A.
Director of University Health Service
G. E. Wodehouse, M.C., M.D., F.R.C.P.
Assistant Director of University Health Service—Women
Miss F. H. Stewart, B.A., M.D.
Director of the Placement Service . . J. K. Bradford, O.B.E., M.A.SC.
Director of Athletics and Physical Education—Men W. A. Stevens, B.S.
Director of Athletics and Physical Education—Women Miss Z. Slack, B.A.
General Secretary-Treasurer of the Students' Administrative Council
E. A. Macdonald, B.A.
Director Hart House Theatre . . . . R. S. Gill, M.A.

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean . . . . R. R. McLaughlin, M.A.SC., M.A., PH.D.
Assistant Dean and Secretary . . . . . W. S. Wilson, E.D., B.A.SC.
Assistant Secretary . . . . J. A. Gow, B.A.SC.

SECTION III. TEACHING STAFF

1961–62

DEAN EMERITUS

C. R. YOUNG, B.A.SC., C.E., LL.D., D.ENG., D.ès.SC.A., HON. M.E.I.C., M.AM.SOC.CE. — 278 Chaplin Cresc.
Dean Emeritus, Faculty of Applied Science and Engineering

PROFESSORES EMERITI

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Professor Emeritus of Mechanical Engineering

J. W. BAIN, B.A.SC., LL.D., F.R.S.C. — 30 Burton Rd.
Professor Emeritus of Chemical Engineering

J. R. COCKBURN, M.C., V.D., B.A.SC. — 100 Walmer Rd.
Professor Emeritus of Engineering Drawing

T. R. LOUDON, V.D., B.A.SC., C.E., HON. F.C.A.I. — 189 Sheldrake Blvd.
Professor Emeritus of Civil and Aeronautical Engineering

W. J. T. WRIGHT, M.B.E., B.A.SC., B.A. — 126 Melrose Ave.
Professor Emeritus of Engineering Drawing

DEPARTMENT OF APPLIED PHYSICS

Professor and Head of the Department

K. B. JACKSON, B.A.SC., D.SC.(WATERLOO) — 362 Glengrove Ave. W.

Associate Professor

V. L. HENDERSON, B.A.SC., A.M.(MICH.) — 397 Glengrove Ave. W.

Assistant Professor

F. B. FRIEND, B.A.(MCM.), M.A.(ROCH.) — 25 Lockie Ave., Agincourt

Lecturers

J. R. BIRD, B.A.SC., M.A., PH.D. — 28 Brownlow Ave.
MISS M. G. CURRIE, B.A.SC. — 89 Broadway Ave.
D. J. GERRARD, B.SC.F. — 70 Rowanwood Ave.
L. M. STEINBERG, B.A. — 54 St. Patrick St.
J. VLCEK, B.SC.F. (U.N.B.) M.A.SC. — 15 Talwood Dr., Don Mills

Lecturer (part-time)

J. CHISVIN, B.SC.(MAN.) — 143 Waterloo Ave., Haviland P.O.

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

Professor and Head of the Department

J. G. Breckenridge, b.a.sc., ph.d. (cantab.) — 23 Douglas Cres.

Professors

W. F. Graydon, m.a.sc., ph.d. (minn.) — North Drive, R.R.1, Weston
R. R. McLaughlin, m.a.sc., m.a., ph.d. — 102 Glen Rd.
W. H. Rapson, m.a.sc., ph.d. — 53 Pine Cres.

Associate Professors

W. H. Burgess, b.ch.e., m.f.s., ph.d. (corn.) — 57 Ridley Blvd.
R. E. Jervis, m.a., ph.d. — 21 High Hill Dr., Agincourt
W. G. MacElhinney, m.a.sc. — 1459 Stavebank Rd., Port Credit
R. W. Missen, m.sc. (qu.), ph.d. (cantab.) — 648 Broadway Ave.
I. H. Spinner, m.a.sc., ph.d. — 28 Sealcove Dr.

Associate Professor of Nuclear Engineering

D. G. Andrews, m.a. (cantab.) — 450 Saville Cres., Oakville

Assistant Professors

R. L. Hummel, b.s. (purdue) — Apt. 6, 68 Kendal Ave.
S. Sandler, m.a.sc. — 5 Evanstone Dr., Downsview
O. Trass, b.s.e. (princ.), sc.d. (m.i.t.) — Apt. 409, 206 St. George St.

Lecturers

C. C. Barnes, b.sc. (qu.) — 894 Avenue Rd.
J. Binkiewicz, dip.chem.eng. (lwow) — 38 Nina St.
Z. May, dip.ing.chem. (warsaw) — 29 Linden St.

Special Lecturer

C. P. Brockett, b.sc. (m.i.t.) — 60 Crescent Rd.

Special Part-time Lecturers

O. W. Berg, fil.kand (lund), m.a. — 230 Spadina Rd.
J. D. Ford, b.eng. (mcg.), m.a.sc. — 121 Southill Dr., Don Mills
F. A. Lenzi, b.sc. (edin.), m.a.sc. — 305 Dupont St.

Instructors

J. K. Affleck, b.a.sc. — 459 Glengarry Ave.
H. A. Fair, b.a.sc. — 126 Rykert Cres.
O. B. Phillips, b.sc. (mcg.) — 22 Montclair Ave.

Demonstrators

M. Bergman, dip.chem.eng. (zur.), ph.d. (geneva) — 931 College St., Y.M.C.A.

Demonstrators (part-time)

D. A. Brandreth, m.s. (penn.) — 50 Prince Arthur Ave.
C. M. D. Burns, b.a.sc. — 89 St. George St.
C-Y. Chan, b.sc. (taiwan) — 229 Beverley St.
H. A. Clarke, b.sc. (lond.), dip.chem.tech. (u.c.w.i.) — 586 Spadina Ave.
D. W. Colcleugh, m.a.sc. — Apt. 1116, 700 Ontario St.

J-C. Corbi, B.SC.(ALEX.), M.A.SC.	Apt. 76, 29 Avenue Rd.
C. S. Gaillard, B.SC.(ALTA.)	299 Avenue Rd.
P. M. Guidote, B.S.CH.E.(SANTO TOMAS)	28 Dalton Rd.
H. P. Kasserra, B.A.SC.	404 Huron St.
R. Luus, B.A.SC.	410 Soudan Ave.
I. R. Moore, B.A.SC.	267 St. George St.
J. C. J. Munro, B.A.SC.	63 Shrewsbury Square, Agincourt
S. I. Olvet, B.A.SC.	2368 Queen St. E.
V. V. Rao, B.CHEM.E.(BOMBAY)	70 Henry St.
S. Ray, B.SC.(CALCUTTA)	694 Spadina Ave.
M. T. Scholtz, B.SC.(CAPE TOWN), M.A.SC.	20 Dundurn Cres.
J. J. Steyn, B.A., B.A.I.(DUB.)	Apt. 8, 467 Spadina Rd.
J. Tai Pow, B.SC.(LOND.), DIP.CHEM.TECH.(U.C.W.I.)	Apt. 1012, 700 Ontario St.
D. J. Whistance, B.SC.(LOND.)	400 Hillsdale Ave. E.
C-H. Wu, B.S.(TAIWAN)	34 Sussex St.

DEPARTMENT OF CIVIL ENGINEERING

Professor and Head of the Department	
C. F. Morrison, B.E.(SASK.), M.SC.(MCG.)	21 Douglas Cres.
Professors	
M. W. Huggins, M.A.SC.	531 Windermere Ave.
O. J. Marshall, B.A.SC., C.E., O.L.S.	48 Haddinton Ave.
W. L. Sagar, E.D., B.A.SC., C.E.	5 DuMaurier Blvd.
Associate Professors	
M. M. Davis, B.SC.(QU.), M.SC.(PURDUE)	112 Three Valleys Dr.
C. E. Helwig, M.A.SC.	89 Woodlawn Ave. W.
C. Hershfield, B.SC.(MAN.), M.A.SC.	3 Windmill Rd.
G. Kani, DR.ING.(STUTTGART)	57 Castle Frank Cres.
H. L. Macklin, B.A.SC., O.L.S., D.L.S.	29 Blyth Hill Rd.
C. A. Wrenshall, B.E.(SASK.)	358 Spring Garden Ave.
Assistant Professors	
J. D. Barber, M.A.SC.	7 Wythenshawe Wood
A. P. Bernhart, DIPL.ING.(GRAZ), DR.TECH.(GRAZ)	23 Cheritan Ave.
R. A. Collins, B.A.SC., M.S.(ILL.), PH.D.(ILL.)	44 Chatsworth Dr.
A. C. Davidson, B.SC., C.E., B.SC., E.E.(MAN.), M.A.SC.	106 Bideford St.
F. A. De Lory, B.ENG.(MCG.), M.A.SC., D.I.C.(IMP.), PH.D.(LOND.)	34 Farnham Ave.
C. W. Dillane, B.A.SC.	23 Castleknock Rd.
H. R. Frizzle, B.SC., E.E.(N.S.TECH.)	29 Anndale Dr.
B. J. Haynes, B.A.SC., O.L.S.	8 Devrock Cres.
D. J. L. Kennedy, B.A.SC., M.S.(ILL.), PH.D.(ILL.)	32 Deevale Rd.
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Lecturers	
S. J. G. Bird, B.A.SC., O.L.S.	281 St. Clements Ave.
V. P. Borecky, DIPL.ING.(PRAGUE), M.A.	265 Ellis Ave.

B. J. Goodal, B.A.SC., M.S.(ILL.)	276 St. George St.
R. C. Gunn, M.A.SC.	(On leave of absence for the session)
E. Karuks, M.A.SC.	35 Burgess Ave.
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M. G. Tallon, B.A.SC.	80 Chelford Rd.
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Instructors	
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L. M. Phillips (MISS), M.A.	35 Hawthorne Ave.
A. A. Rose, B.A.SC.	20 Whitelock Cres.
D. G. Wight, B.SC.(EDINBURGH)	194 Kenilworth Ave.
G. H. Wilkes, B.A.SC.	2330 Sheppard Ave. W.

DEPARTMENT OF ELECTRICAL ENGINEERING

Professor and Head of the Department	
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Professors	
J. M. Ham, B.A.SC., SC.D.(M.I.T.)	135 Glencairn Ave.
J. E. Reid, B.A.SC.	152 Donegal Dr.
G. Sinclair, M.SC.(ALTA.), PH.D.(OHIO STATE)	62 Felbrigg Ave.
V. G. Smith, B.A.SC.	142 Dawlish Ave.
Associate Professors	
P. P. Biringer, DIP.ING.(BUD.), M.SC.(STOCKHOLM), PH.D.	6 Lumley Ave.
A J. Kravetz, B.SC.(ALTA.), M.A.SC.	500 Riverside Dr.
G. R. Slemon, M.A.SC., PH.D.(LOND.), D.I.C.(IMPERIAL COLL.)	40 Chatfield Dr.
Assistant Professors	
P. E. Burke, B.E.(N.S. TECH.), M.A.SC.	1 Terrington Court, Don Mills
H. A. Courtice, B.A.SC.	166 Parkview Hill Cresc.
I. R. Dalton, B.A.SC., M.S.(NORTHWEST.)	20 Wilgar Rd.
R. J. Kavanagh, B.SC.(U.N.B.),M.A.SC., PH.D., D.I.C.(IMPERIAL COLL.)	100 Colin Ave.
A. Straughen, B.SC.(LOND.), M.A.SC.	25 Maxwell Ave.
J. L. Yen, B.SC.(CHIAO TUNG), M.A.SC., PH.D.	20 Swiftdale Pl.
Lecturers	
W. Janischewskyj, B.A.SC., M.A.SC.	65 Humbercrest Blvd.
E. S. Lee, B.ENG., M.ENG.(MCG.)	3 Eccleston Dr., Apt. 215
G. O. Martens, B.SC., M.A.SC.	165 Jameson Ave., Apt. 507

Special Lecturer

M. M. Sondhi, b.sc.(delhi), ph.d.(wis.) — 143 Arlington Ave.

Instructors

T. F. Howlett, b.a.sc. — 2273 Lake Shore Rd., Burlington
Mrs. S. Mosher, e.e.(odessa), m.a.sc. — 78 Roseneath Gdns.
Miss K. Samuels, b.a.sc. — 54 Pinewood Ave.

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E. H. Oldham, b.a.sc. — 63 Hill Cresc., Scarborough
N. M. Petrykanyn, b.a.sc. — 122 Fifth St., Apt. 7
O. Poldne, b.a.sc. — 1607 Victoria Park Ave., Apt. 306
B. F. Smith, b.a.sc. — 2 Grandstand Pl., Apt. 603
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Demonstrators (part-time)

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R. L. Hicks, b.sc.(qu.) — 378 Davisville
E. A. Jordan, b.a.sc. — 48 Woodland Park Rd.
R. A. Martin — Room 147, Galbraith Bldg.
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DEPARTMENT OF MECHANICAL ENGINEERING

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Y. H. Chung, B.SC. (SOOCHOW), M.A.SC. — 421 The Heights Dr., Don Mills
R. O. King, M.A.SC. (MCG.) — Mechanical Bldg.
R. Strom, B.A.SC. — 28 Evanston Dr., Downsview
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Demonstrators

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M. C. E. Bell, b.a.sc. 182 St. George St.
E. U. Chukukere, b.a.sc. 53 Robert St.
G. S. Cole, m.a.sc. 85 Wellesley St. E.
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W. H. Mak, b.a.sc. — 30 Madawaska Ave.
R. C. Radford, b.a.sc. — 88 Chatham Ave.
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SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant-Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers, and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate, by statute subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909–1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910–1911. In the session 1923–24 the degree was changed to B. Arch. for the students graduating in Architecture. On July 1, 1948, the School of Architecture was separated from the Faculty and became an independent School with its own Director and Council.

With the end of the Second World War during the summer of 1945 the University was faced with the difficult problem of providing accom-

modation for almost double the number of students that had been registered in the previous year. Through the efforts of the Chairman of the Board of Governors and the President, the University leased from the Crown part of the large shell-filling plant at Ajax, twenty-five miles east of Toronto, to relieve the heavy demand for space at Queen's Park. Because it became evident, at an early stage, that a relatively large number of students would register in the Faculty of Applied Science and Engineering, it was decided that the work of the First and Second Years of this Faculty should be given at Ajax.

A special First Year session with approximately 1400 students commenced at Ajax on January 14, 1946. In the regular 1946–47 session both First and Second Year instruction, except Second Year in Architecture, was given at Ajax with 1800 registered in the First Year and 1500 in the Second Year. In the 1947–48 session the enrolment at Ajax consisted of 1200 students in the First Year and 1400 in the Second Year. In the session 1948–49, 600 were registered at Ajax in the First Year and 975 in the Second Year. All other instruction was given in Toronto.

To provide for this self-contained University community at Ajax, there were 446 acres and 111 buildings. The University operated such services as central heating, road maintenance, water supply, sewage disposal, fire department, transportation, post office, laundry, private hospital, cafeteria, tuck shop and barber shop. Former production-line buildings were altered to accommodate 37 lecture rooms, 20 draughting rooms and 14 laboratories. In the 1946–47 session, 2300 students were in residence, in 1947–48 there were 1800 students and in 1948–49 there were 900. Student life at Ajax compared favourably with that in Toronto, excellent accommodation being provided for a general circulating library, a technical library, Hart House Ajax, the Athletic Association, the Health Service, Students' Administrative Council, Advisory Bureau for Ex-Service Students, and a small chapel.

Meanwhile, the erection of the Wallberg Building and an addition to the Mechanical Building was in progress, and with this additional accommodation becoming available on the Queen's Park campus, Ajax was closed on May 31, 1949.

The long-felt need for additional space for Civil Engineering and Electrical Engineering, and the projected expansion of the University as a whole to meet the expected demand for greatly enlarged enrollment, led to the construction of the Galbraith Building. Partially occupied during the 1960–61 session it was officially opened on March 7th, 1961, by the Honourable J. Keiller Mackay, D.S.O., V.D., Q.C., LL.D., D.C.L., Lieutenant Governor of Ontario. The building houses Civil Engineering, Electrical Engineering, the Institute of Aerophysics, and the Faculty Office.

SECTION V. GENERAL INFORMATION, ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

RESTRICTION OF REGISTRATION

The right is reserved to limit the number of students admitted to any course in the Faculty.

1. ADMISSION REQUIREMENTS

A candidate for admission to the first year must present the Ontario Grade XIII certificate or an equivalent certificate showing standing in the following subjects:

English:	Literature Composition	
Mathematics:	Algebra Geometry Trigonometry	
Science:	Chemistry Physics	
One of:	French German Greek Italian Latin Spanish Russian	*Authors and Composition*

For admission to Civil, Mining, Mechanical, Industrial, Chemical, Electrical and Metallurgical Engineering, and to Applied Geology, an overall average of at least 64% on these subjects is required.

For admission to Engineering Science, an overall average of at least 70% on these subjects is required. Further information concerning the course in Engineering Science will be found on page 45 of this calendar. Students intending to pursue work in Aeronautical/Astronautical Engineering will register in Engineering Science. For further information, refer to pages 45 and 64.

Preferential consideration will be given to candidates who have completed the University admission requirements at the end of one session in Grade XIII in Ontario schools or in one sitting in other school systems. Applications will also be considered in the light of the Principal's Report, the previous school record of the applicant and other tests of the student's ability that are available.

2. EQUIVALENT CERTIFICATES

The following certificates are usually accepted as equivalent to Ontario Grade 13 although individual subjects cannot always be equated. Standing in the following certificates is required as outlined in (1) above. Specific details on the standing required from applicants who have not been educated in Ontario will be supplied by the Department of Admissions, Office of the Registrar, on request.

Canada:

Alberta, Manitoba, Nova Scotia, Saskatchewan—Grade 12.
British Columbia, New Brunswick—Senior Matriculation.
Newfoundland—First Year Memorial University.
Prince Edward Island—Third Year Certificate of Prince of Wales College.
Quebec—Senior High School Leaving Certificate; McGill Senior School Certificate; English Catholic Senior High School Leaving Certificate.

England, West Indies, East and West Africa:

General Certificate of Education showing either

(a) Passes in five subjects of which at least two must be passed at advanced level; or

(b) Passes in four subjects of which at least three must be passed at advanced level.

In either case, passes are required in Physics, Chemistry, and an acceptable mathematical subject. At least two of these must be at advanced level.

School and Higher School Certificates are accepted on the following basis:

Credits on the School Certificate are accepted as ordinary level passes on the General Certificate of Education; subsidiary passes on the Higher School Certificate as ordinary level passes on the General Certificate of Education; and principal or main subject passes on the Higher School Certificate as advanced level passes on the General Certificate of Education.

Hong Kong:

General Certificate of Education or School and Higher School Certificates as stated above; University of Hong Kong Matriculation Certificate on same basis as General Certificate of Education.

United States of America:

A United States High School Graduation Diploma will not admit an applicant to this Faculty.

First Year College credits in the required subjects from accredited institutions will be accepted for admission, provided satisfactory standing is obtained and the approximate number of semester hours of credit obtained as indicated:

English (including an intensive course in Literature)	6
Algebra	3
Analytical Geometry	3
Plane Trigonometry	3
Physics	3
Chemistry	3
A language other than English	6

Applicants seeking admission on the basis of certificates not included in the above are advised to submit photostatic copies of their certificates to the Registrar of the University for evaluation. When these certificates are in a language other than English, notarized English translations must accompany the photostatic copies.

3. ADMISSION REGULATIONS CONCERNING CANDIDATES WHO HAVE PREVIOUSLY FAILED

(a) A candidate who for the first time has failed a year at the University of Toronto or who has failed once at another institution of higher learning may be considered for admission to the University of Toronto subject to debarment.

(b) Students who on two occasions have failed to secure the right to advance to a higher year in university work will be debarred from registration in any division of the University of Toronto affected by the debarment regulations of the Senate (see page 25 of this calendar).

4. MATURE STUDENTS

(a) *Admission Regulations*

Candidates of mature age (30 years or older on October 1 of the session to which admission is sought) who have lived in Ontario for a minimum period of one year, may request special consideration if they have not completed in full the published Grade XIII (or equivalent) requirements. Such applicants must submit a birth certificate at the time of application.

(b) *Probationary Status*

Candidates accepted by the Senate's Committee on Admissions as mature students are admitted on probation.

Mature students, registered in full-time day courses, must obtain standing in their first year of full-time study in order to have their probationary status removed. If they do not obtain standing they will not be allowed to repeat the year or to enroll in any other course in the University of Toronto until they present in full the published admission requirements.

5. ENGLISH FACILITY REQUIREMENTS

All applicants are required to submit evidence acceptable to the University of Toronto of facility in English. The following evidence is acceptable:

(a) The University of Michigan English Language Test. This test is conducted periodically at the University of Toronto for residents in the Toronto area. Applications to write the test in Toronto may be obtained from the Department of Admissions, Simcoe Hall, University of Toronto.

(b) The Certificate of Proficiency in English issued by the Universities of Cambridge or Michigan.

Information about writing the tests in (a) or (b) above in overseas centres may be obtained from the Department of Admissions, Simcoe Hall, University of Toronto.

(c) Standing in English Composition in the Ontario Grade XIII Certificate, or other certificates recognised by the University of Toronto as equivalent.

The University is prepared to consider other evidence of English Facility which may be submitted for evaluation to the Registrar of the University.

6. PROCEDURE FOR ADMISSION

Application forms may be obtained from the Department of Admissions, Office of the University Registrar, Simcoe Hall, University of Toronto. Applications for admission to undergraduate degree and diploma courses should be completed in accordance with the procedures outlined below and *should be submitted as early as possible in the year for which the candidate seeks admission.*

Provisional Admission Arrangements

Provisional Admission will give by June to well-qualified applicants attending Ontario schools an assurance of admission. It will be granted on the basis of the high school record and other information contained in the regular University application and the Principal's Confidential Report. Applicants who are judged to qualify for provisional admission will be told that a place in the University is being reserved for them, and that they will receive automatic confirmation of this preliminary offer of admission if they achieve in their Ontario Grade 13 examinations a stated overall average (specified in the letter of provisional admission) and if they meet the subject requirements for the course of their choice. The last date by which the University will accept applications which will be considered for the provisional admission arrangements is March 1.

Terminal Dates for Submission of Applications and Certificates

1. March 1, 1962—Applications to come under the Provisional Admission arrangements.
2. June 1, 1962—All applications for admission.
   Only in circumstances which the Committee on Admissions deems exceptional will a late application be considered.
3. July 1, 1962—All certificates which have been issued before this date.
4. Sept. 1, 1962—Certificates (including Ontario Grade XIII) issued on or after July 1, 1962.

Application for Admission to First Year

Candidates seeking admission to undergraduate degree and diploma courses must submit to the Department of Admissions, Office of the University Registrar, Simcoe Hall, completed application forms and the following documents:

(i) Ontario Grade XIII or an equivalent certificate, indicating the subjects studied and the grades obtained;

(ii) Candidates who have previously attended a university or college for *any* period of time, must submit the following:

(a) official transcripts of record from the university attended, indicating all courses studied, the grades secured in each (whether passes or failures), and statement of honourable dismissal;

(b) a calendar of the university giving full descriptions of the courses studied.

Application for Admission with Advanced Standing

Candidates seeking admission on advanced standing basis must submit to the Department of Admissions, Office of the University Registrar, Simcoe Hall, prior to the dates mentioned above, completed application forms and the documents outlined in (i) and (ii) above.

7. HEALTH REQUIREMENTS AND REGISTRATION PROCEDURES

(a) Every person admitted to the University as an undergraduate must, at the time of his or her first medical examination by the University Health Service, present satisfactory evidence of successful vaccination, or must be vaccinated by the examining physician.

(b) A student who fails to register at the prescribed time will be required to pay an additional fee of $10.00 for late registration to the Chief Accountant. The Council of the Division to which an applicant has been admitted may at its discretion refuse a student permission to register late.

(c) A student must comply with such other registration procedures as may be required by the University.

8. PROCEDURE FOR TRANSFERS AND WITHDRAWALS

A student desiring to transfer to another division of the University or to withdraw from the University, must surrender his Admit-to-Lectures Card to the appropriate officer of the division concerned and must complete withdrawal forms as required by the University. In order that adjustment of fees may be made, notice of transfer or withdrawal must be completed without delay. In the case of a student who wishes to transfer to another division at the time of first admission to the University, it is required that such a student apply for an amended admission letter to the Registrar of the University.

9. DEBARMENT REGULATIONS OF THE UNIVERSITY*

Subject to other statutes and regulations of the University,

(a) any student who on two occasions fails to secure the right to advance to a higher year in University work shall be debarred from registration in the University.

(b) any student who withdraws after February 15, or who does not withdraw but does not write the annual examinations, shall be regarded for the purposes of debarment from the University as having failed his year.

Petitions relating to the debarment regulations will in the first instance be submitted by the appellant to the Office of the University Registrar for consideration by the Senate's Committee on Applications and Memorials.

SPECIAL STUDENTS

Graduates of the University of Toronto and of recognized universities who wish to take one or more undergraduate subjects may be registered as special students in the Faculty of Applied Science and Engineering, subject to the approval of the teaching department concerned. Application must be made to the Secretary of the Faculty.

RESIDENCE ACCOMMODATION

There is a University Men's Residence (Devonshire House) for which men undergraduates are eligible but which can accommodate only a small percentage of them. Early application is advisable. Apply to the Secretary, Men's Residences, Simcoe Hall.

Each of the four Arts Colleges also maintains a Men's Residence into which some engineering students are accepted. Further information may be obtained from:

University College—Dean of Men
Victoria College—Senior Tutor
Trinity College—Registrar, Trinity College
St. Michael's College—The Superior

HOUSING SERVICE

For those students who are not accommodated in the University and College residences, the Students' Administrative Council prepares annually a list of rooming houses, flats, apartments and homes. This list may

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*These regulations apply to students enrolled in all Divisions of the University *except* the Faculty of Law, the Professional years in the Faculty of Medicine, the School of Social Work, the Ontario College of Education, Library School, the School of Graduate Studies and all other Post Graduate Divisions of the University.

be consulted at the housing office in The Students' Administrative Council building after 1st August and throughout the session.

To meet the housing shortage in Toronto, the Students' Administrative Council has greatly expanded its Housing Service. Every effort is being made to provide family accommodation for married students. Information may be obtained from the Students' Administrative Council's Housing Service office, the Observatory.

Through this service many opportunities have been afforded students, including students who are married, to obtain lodgings and board in exchange for part-time service. Students desiring this type of accommodation are asked to indicate this when they apply.

CHILDREN OF WAR DEAD (EDUCATION ASSISTANCE) ACT

Children of War Dead (Education Assistance) Act provides fees and monthly allowances for children of veterans whose death was attributable to military service. Enquiries should be directed to the nearest District Office of the Department of Veterans Affairs.

SECTION VI. FEES, DEPOSITS AND EXPENSES

FEES

1. A student who desires to enrol in the Faculty of Applied Science and Engineering is required to pay at least the First Term Instalment of fees on or before the opening date of the session, and before he can receive his registration card from the Secretary of the Faculty. The amount of the First Term Instalment of fees or of the Total Fee for the session may be ascertained from the schedule of fees below.

2. The Second Term Instalment of fees, if not already paid, is payable on or before January 15. After this date an additional fee of $3.00 per month or portion thereof (not exceeding $10.00), will be imposed until the whole amount is paid. All fees for the session must have been paid in full before the student can be admitted to the annual examinations.

3. In order to avoid delay in registration at the opening of the session it is recommended that at least the First Term Instalment of fees be forwarded by mail as early as possible in September, together with a form, in duplicate, to be provided by the Secretary of the Faculty and filled out by the student, giving his full name, course, year, etc.

4. University fees are payable at the Office of the Chief Accountant, Simcoe Hall, which will be open for the receipt of fees from 9 a.m. to 5 p.m. daily from September 4 to 18 and from 9 a.m. to 1 p.m. daily except Saturday during the remainder of the session. Cheques in payment of these fees should be made payable to the University of Toronto at par in Toronto.

5. Each undergraduate enrolled in the Faculty of Applied Science and Engineering must pay annual fees to the Chief Accountant according to the schedule below; the total fee in each case is made up of the academic fee and incidental fees; all incidental fees are payable in the first term.

Schedule of Fees

Academic Year	*Academic Fee	†Incidental Fees	Total Fee (if paid in one instalment)	First Term Instalment	Second Term Instalment
		Men			
I-IV	$600	$57	$657	$357	$303
		Women			
I-IV	$600	$31	$631	$331	$303

*The Academic Fee includes the following fees:—
Tuition; Library and Laboratory Supply; one Annual Examination; Laboratory Fee; Physical Education; and Degree.

†These Incidental Fees include the following fees:—
For men—Hart House; Students' Administrative Council; Athletic; Health Service; Engineering Society; Faculty Athletic Association.
For women—Students' Administrative Council; Athletic; Health Service; Engineering Society.

6. A late registration fee of $10.00 will be assessed against any student who registers after the last date for normal registration in his or her faculty or school.

OTHER UNIVERSITY FEES

7. Each student is required to pay to the Chief Accountant at the opening of the session, or as otherwise specified, such of the following fees as may be required of him.

EQUIVALENT CERTIFICATE FEE

8. Each student who has been admitted to the First Year upon a certificate or certificates granted outside the Province of Ontario and covering all or any part of the admission requirements, must pay a fee of $5.00.

ADVANCED STANDING FEE

9. Each student who has been admitted to advanced standing from another university or college, must pay a fee of $10.00.

SPECIAL PHYSICAL EDUCATION FEE

10. Each student who has neglected to complete satisfactorily the course in Physical Education of the First Year, and who must take this work during the Second Year of his or her attendance must pay a fee of $50.00.

SUPPLEMENTAL EXAMINATION FEES

11. Each candidate for a supplemental examination is required to pay a fee to the Chief Accountant not later than July 27. The fee is $10.00 for one subject and $5 for each additional subject, including laboratory supplementals. For each supplemental examination in a laboratory subject requiring special supervision, there is an additional fee of $10.00. The additional laboratory supplemental fee should not be paid until the candidate is notified by the Secretary.

SPECIAL STUDENTS FEES

12. The fee is $85.00 per subject, payable to the Chief Accountant.

SUMMARY OF STUDENTS' EXPENSES

13. The following approximate statement of expenses will give the student a general idea of the cost of obtaining an education in the Faculty of Applied Science and Engineering in the University of Toronto, exclusive of personal expenses:—

1. Fees, see schedule page 27.
2. Board and Lodging, per week ....$20.00 up
3. Books and instruments, per year ....about $100

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating course in which he intends to proceed to a degree. There are nine courses in Engineering, from which the selection may be made, viz.,

Civil Engineering (Course 1),
Mining Engineering (Course 2),
Mechanical Engineering (Course 3),
Industrial Engineering (Course 4),
Engineering Science (Course 5), (formerly Engineering Physics)
Chemical Engineering and Applied Chemistry (Course 6),
Electrical Engineering (Course 7),
Metallurgical Engineering (Course 8),
Applied Geology (Course 9),
Aeronautical/Astronautical Engineering (see page 64).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the above courses.

3. The courses extend over four academic years. A student must pass in the work of each academic year before proceeding to the work of the next. See Sec. IX.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 15.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction are given in Sec. VIII.

7. Examinations are conducted as explained in Sec. IX.

8. Students in Civil Engineering, Mining Engineering, Mechanical Engineering, Industrial Engineering, Chemical Engineering, Electrical Engineering, Metallurgical Engineering and Applied Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. (See Sec. VIII.)

GRADUATE STUDY AND RESEARCH

Facilities are available in the Departments of the Faculty, for graduates with good records of this University or of another University of comparable standing, for post-graduate study and research leading to

the degrees of Master of Applied Science (M.A.Sc.) and Doctor of Philosophy (Ph.D.). For further information see the Calendar of the School of Graduate Studies. In some cases financial support for equipment and salaries of research assistants may be obtained through the School of Engineering Research, an organization within the Faculty established by the late Dean Ellis in 1917, or from other sources.

Bursaries and Scholarships for graduate students are available in limited number as shown on page 134. Many part-time demonstratorships are open which permit post-graduate work towards a degree.

INTERIM HIGH SCHOOL ASSISTANT'S CERTIFICATE TYPE A

Graduation in Engineering Physics is accepted by the Ontario College of Education as meeting the academic requirements for admission to the course leading to a Type A certificate in Mathematics and Physics.

Graduates in electrical engineering who obtain at least 66% in the final year of the course will be eligible for endorsement in mathematics and physics.

Graduates in chemical engineering who obtain at least 66% in the final year of the course will be eligible for endorsement in physics and chemistry.

Inquiries regarding the requirements for these certificates should be directed to the Ontario College of Education.

ASSOCIATIONS OF PROFESSIONAL ENGINEERS

Graduation from the Faculty of Applied Science and Engineering leads to registration as a Professional Engineer in the various Associations of Professional Engineers throughout Canada.

SECTION VIII. CURRICULUM

The courses are designed to give the student a thorough grounding in the fundamentals of engineering, with emphasis on their practical application in the field in which he has chosen to study. In the First Year there is little differentiation between the various courses with the exception of Engineering Science. In the succeeding years, specialization develops to a considerable extent, with provision in the Third and Fourth Years for optional subjects in some of the courses.

The Faculty has excellent laboratory facilities, in which the students do practical experiments and problems related to the lecture subjects. In some graduating courses, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances, the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. As part of the laboratory instruction, excursions to places of technical interest are arranged by the staff. These excursions are treated as laboratory periods, with the same requirements as to attendance and reports.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As engineering works necessarily involve considerations of organization, economics and finance, it is essential that those entering the profession should have a basic knowledge of these subjects.

As in the case with other professions, the engineer should be prepared to assume positions of professional and community leadership. Accordingly, the curriculum contains a basic core of humanistic-social studies, including English, Political Science, Economics, Modern History, and Philosophy of Science. It is hoped that this introduction to the humanities will stimulate the student to do further reading and study, thereby increasing his professional effectiveness.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The programme and regulations regarding the courses of study and examination, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course to the conditions here laid down.

Communications relating to curricula, instruction, and examinations in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information regarding the courses of study leading to the post-graduate degrees, Master of Applied Science, and Doctor of Philosophy, see the calendar of the School of Graduate Studies, which gives full particulars.

FIRST YEAR CURRICULUM

The courses in Mechanical Engineering. Industrial Engineering, Chemical Engineering, Electrical Engineering and Metallurgical Engineering, designated as Division A have a common First Year and the courses in Civil Engineering, Mining Engineering and Applied Geology have a common First Year differing from that of Division A only in that Surveying is included. The First Year curriculum in Engineering Science is designated as Division C.

A student, on petition to the Council, may be permitted to change his course at the end of the First Year.

FIRST YEAR CURRICULUM

Division A		Division B
Mechanical Engineering		Civil Engineering
Industrial Engineering	and	Mining Engineering
Chemical Engineering		Applied Geology
Electrical Engineering		
Metallurgical Engineering		

First Year Subjects Divisions A & B	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	221, 222	2	3	2	3
Engineering Problems and Drawing	275	–	6	–	6
English	610	1	–	1	–
Political Science	323	1	–	1	–
Mathematics:					
Analytical Geometry	492, 275	1	3	1	3
Calculus	490, 275	2		2	
Descriptive Geometry	269	1		1	
Physics:					
Electricity	330, 677	2	3	2	3
Mechanics	20, 677	2		2	
Structure and Properties of Matter	676, 677	2		2	
Physical Education	640	–	2	–	2
Practical Experience	690	–	–	–	–
Surveying (Division B only)	710, 712	1	3	–	–

Division C
Engineering Science

First Year Subjects Division C	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	223, 222	2	3	2	3
Engineering Problems and Drawing	276	–	6	–	6
English	610	1	–	1	–
Political Science	323	1	–	1	–
Mathematics:					
Algebra and Geometry	502, 276	2	–	2	–
Calculus	503, 276	2	–	2	–
Descriptive Geometry	269	1	–	1	–
Physics:					
Electricity	331	2	–	2	–
Statics	21	2	–	–	–
Properties of Matter; Mechanics and Heat	650, 651	3	4	3	4
Physical Education	640	–	2	–	2

CIVIL ENGINEERING

(Course 1)

The course in Civil Engineering has been so designed as to be broad and comprehensive. It has been designed not only to meet the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire an engineering education of such a basic character as to enable them to enter various other fields of engineering employment.

In addition to instruction in engineering subjects, sufficient time is assigned to economic, legal and administrative studies to qualify the graduate in this course not only to engage in any of the branches of Civil Engineering but also to do administrative or executive work in industrial, commercial, government or other undertakings of an engineering character.

In the final year four options are offered:

A—Structural
B—Surveying
C—Municipal and Sanitary
D—Transportation and Soil Mechanics

Because of the common core of Civil Engineering material in the course, a graduate in any option will not be at a serious disadvantage

when engaged in engineering work that is more closely associated with one of the other options.

Most of the subjects in the Third Year are taken by all students, but, in addition to these common subjects, students proceeding to options A, C, and D in the Fourth Year must take the Group A subjects while those proceeding to option B must take the Group B subjects.

The subjects of instruction are shown in the following tables. In these tables numbers have been assigned to the subjects which refer to a more detailed description of each, e.g., Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	367, 368	2	$1\frac{1}{2}$	–	–
Applied Physics..............	70, 71	2	3	–	–
Calculus....................	491	2	–	2	–
Dynamics...................	22	–	–	2	–
Economics..................	311	2	–	2	–
Engineering Chemistry........	226	2	–	–	–
Engineering Geology.........	382, 383	2	1	1	2
Engineering Thermodynamics..	434	–	–	2	–
Engineering Problems and Drawing..............	284	–	6	–	6
Mechanics of Materials.......	34, 31	2	–	2	3
Physical Metallurgy..........	538	–	–	2	–
Practical Astronomy..........	200	–	–	2	–
Practical Experience..........	690	–	–	–	–
Surveying..................	714, 716	2	3	1	3

Each student in Civil Engineering is required to state, not later than June 29 following the completion of his Second Year, the group of subjects he desires to pursue in the Third Year. Permission to take either group of subjects must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Third Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Equations (1962–1963 only)	507, 516	1	1½	1	1½
Engineering Geology (1962–1963 only)	382, 383	2	2	1	1
Engineering Thermodynamics (1962–1963 only)	434	–	–	2	–
Fluid Mechanics	440, 441	2	–	2	3
Highway Engineering I	209, 45	2	1½	–	–
Mathematics (starting 1963–1964)		2	1½	2	3
Modern World History	324	2	–	2	–
Municipal Planning, Administration and Transportation	216	–	–	3	–
Practical Experience	690	–	–	–	–
Sanitary Engineering I	208	2	–	–	–
Soil Mechanics	39, 45	2	1½	–	–
Survey Camp	720	–	–	–	–
And either of the following groups of subjects:					
Group A (Leading to options 1A, 1C and 1D)					
Mechanics of Materials II	55, 57	2	6	2	6
Structural Design I	28, 57	2		2	
Structural Theory I	56, 57	–		3	
Group B (Leading to option 1B)					
Geodetic Engineering	206, 207	–	–	2	3
Least Squares (starting 1963–1964)	494	–	–	–	3
Optics and Photogrammetry	75, 76	2	3	–	–
Photo Interpretation	79, 80	–	–	2	3
Structural Engineering I	46, 47	2	1½	2	3

Civil Engineering students selecting the Group A subjects are required to state not later than June 29 following the completion of their Third Year the options (one of options 1A, 1C or 1D) they desire to pursue in the Fourth Year. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Civil Engineering students selecting the Group B subjects in their Third Year, must pursue option 1B in their Fourth Year.

Fourth Year Subjects Course 1 (Session 1962–63 only)	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Construction Management and Business	218	–	–	2	–
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Highway Engineering	217	1	–	1	–
Hydraulic Engineering	445, 446	2	1½	2	3
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Reinforced Concrete	41, 42	2	1½	1	1½
Sanitary Engineering	214, 215	2	1½	2	3
Thesis and Public Speaking*	730	–	–	–	1
And either of the following groups of subjects:					
Group A					
Mechanics of Materials	38	–	3	–	3
Soil Mechanics and Foundations	40, 50	2	–	2	3
Structural Design	43, 54	1	3	1	3
Theory of Structures	36, 37	2	1½	2	1½
Group B					
Adjustment of Observations	523	–	–	–	3
Astronomy	202, 203	1	3	–	–
Geodesy	204, 205	–	–	2	3
Photogrammetry	77, 78	1	3	1	3
Soil Mechanics and Foundations	49, 50	1	–	1	3
Survey Camp	721	–	–	–	–
Town and Regional Planning	219, 220	1	3	–	–

*Topic for Thesis must be submitted by each student for approval not later than Oct. 15, and preferably by the beginning of the first term. The final date for submission of completed, typed thesis is the last day of the first term.

MINING ENGINEERING

(Course 2)

The Mining Engineer is concerned with all aspects of the winning of metals and minerals from their geological environments in the earth's crust, and of their conversion to forms in which they can best be utilized in the growing needs and comforts of man. Thus, the course in Mining Engineering has been designed to prepare its graduates for successful participation in the engineering, operational, and administrative activities of those aspects.

The professional fields concerned include mineral exploration, evaluation and development of mineral properties, the mining of ores from a multiplicity of geological situations by the most advanced methods, the treatment of ores in beneficiating and metallurgical plants, and the economics of mineral markets. For the enhancement of abilities in supervision and management, the administrative viewpoint and attitude are stressed in the professional subjects during the later years of the course.

Building upon a foundation in the disciplines of mathematics, physics, and chemistry, the student proceeds through training in geology, mechanics, electricity, economics, business, and general engineering subjects, to a growing proportion of specifics dealing with the fields which the course is designed to serve. The diversification of this training renders the Mining Engineer capable of successful participation in all branches of industry and commerce.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.* Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
A. C. Circuits I	367, 368	2	1½	–	–
Analytical Chemistry Laboratory	227	–	6	–	–
Calculus	491, 287	2	1½	2	1½
Chemistry	224	2	–	–	–
Economics	311	2	–	2	–
Historical and Stratigraphic Geology	393	–	–	2	1
Mechanics of Materials	23, 31	2	–	2	3
Mineralogy and Lithology	386, 387	2	2	2	2

Second Year Subjects Course 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Mining	165	–	–	1	2
Oral Expression	193	–	–	–	2
Physical Geology	380, 381	2	3	–	–
Practical Experience	690	–	–	–	–
Surveying	715, 717	1	3	2	2

Third Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 161	1	3	1	3
Business	310	–	–	1	–
Elementary Structural Engineering	29, 53	1	–	2	3
Fluid Flow and Pumping Systems	454, 455	3	3	–	–
Geological Field Work	411	–	–	–	–
Engineering Thermodynamics	427, 428	1	–	1	3
Metallurgy	539	–	–	1	–
Mineral Dressing	180, 182	2	–	2	6
Mining	168	3	–	–	–
Mining Laboratory	169	–	3	–	3
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–
Structural Geology	397, 398	1	3	1	3
Summer Essays	192	–	2	–	–
Survey Camp	720	–	–	–	–
Wet Analysis	162	–	3	–	3

Fourth Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Glacial Geology and Ground Water	384, 412	1	–	1	–
Machine Design	469, 470	1	–	1	3
Metallurgy	555, 556	1	–	1	3
Mine Operation and Administration	170, 172	2	2	2	6
Mineral Deposits	399	2	–	2	–
Mine Ventilation	175, 176	2	3	–	–
Mining Geology	405	–	–	2	–
Ore Dressing	183, 184	1	6	1	–
Physical Metallurgy	538	–	–	2	–
Practical Experience	690	–	–	–	–
Precambrian Geology	403	2	1	–	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	5½	–	6

MECHANICAL ENGINEERING

(Course 3)

Traditionally associated with the art and science of power generation and the machinery whereby power is usefully applied, Mechanical Engineering, like other branches of the engineering profession, participates in the rapid advance of scientific knowledge and interprets it in the design and development of practical systems.

The curriculum is based on a broad foundation of mathematics and the fundamental physical sciences and includes a sufficient variety of topics to provide a balanced and challenging professional programme. Current engineering practice in its many aspects is considered while specific attention is directed toward developing the student in the analytical and scientific approach.

While the interests of the mechanical engineer encompass a very wide range of professional activity, his special skills most often lead him into design, development, or management. Representative fields of occupation include: design of mechanisms and machines, precision measurement, vibration analysis, hydraulic systems, materials handling, power generation, aircraft and spacecraft propulsion, refrigeration, heating, ventilating and air conditioning, controls and automation, pumps and compressors, pulp and paper production, gas and oil pipelines.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits	367, 368	–	–	2	1½
Calculus	491	2	–	2	–
Dynamics of Machines	465, 466	3	1½	3	1½
Economics	311	2	–	2	–
Electricity	338, 334	2	3	–	–
Engineering Chemistry	226	2	–	–	–
Engineering Problems and Drawing	286	–	6	–	6
Heat Engines, Elementary	420	–	–	2	–
Mechanical Engineering	461	1	–	–	–
Mechanics of Materials	34, 31	2	3	2	–
Physical Metallurgy	564, 565	2	–	2	1½
Practical Experience	690	–	–	–	–
Treatment of Technical Data	449	–	–	2	–

THIRD YEAR SUBJECTS COURSE 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Business	310	–	–	1	–
Differential Equations	511	2	$1\frac{1}{2}$	2	3
Electronics	345, 346	2	$1\frac{1}{2}$	–	–
Electrical Machines	377, 378	2	$1\frac{1}{2}$	2	3
Engineering Thermodynamics	421, 423	2	3	2	3
Fluid Mechanics	440, 441	2	–	2	3
Heat Engineering	422	2	–	1	–
Machine Design	467, 468	2	$4\frac{1}{2}$	2	6
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–

FOURTH YEAR SUBJECTS COURSE 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Engineering	520	1	3	2	2
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Heat Power Engineering	424, 426	2	3	2	5
Hydraulics	443, 444	2	3	2	5
Industrial Management	315	1	–	–	–
Internal Combustion	425	1	–	1	–
Machine Design	473, 474	2	3	2	5
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Structural Engineering	30, 52	2	3	2	3
Thesis	730	–	1	–	1

INDUSTRIAL ENGINEERING

(Course 4)

The Industrial Engineering course, like the other engineering courses at the University of Toronto, is primarily an education for the profession of engineering. The student is given a substantial foundation in science and mathematics, and in such fundamental engineering subjects as fluid mechanics, applied thermodynamics, electricity, mechanics of materials and machine design.

At the same time, the Industrial Engineering student undertakes a specialization in industrial and engineering analysis. This includes studies in probability and statistics, numerical analysis, operations research, data processing and control theory. Emphasis is placed on the application of these methods in both the economic and technical aspects of industry, and in automatic systems. The student is also introduced to such studies as organizational structure, financial control and industrial psychology.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	367, 368	–	–	2	1½
Calculus....................	491	2	–	2	–
Dynamics..................	22	–	–	2	–
Economics.................	311	2	–	2	–
Electricity.................	338, 334	2	3	–	–
Engineering Chemistry........	226	2	–	–	–
Engineering Problems and Drawing..................	288	–	6	–	6
Mechanical Engineering.......	463, 464	2	–	2	3
Mechanics of Materials.......	23, 31	2	3	2	–
Practical Experience..........	690	–	–	–	–
Probability and Statistics.....	512, 513	2	3	2	3
Physical Metallurgy..........	564, 565	2	–	2	1½

Third Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Accounting..................	306	2	–	2	–
Differential Equations........	511	2	–	2	–
Electronics.................	345, 346	2	1½	–	–
Elementary Structural Engineering................	29, 53	1	–	2	3
Fluid Mechanics.............	440, 441	2	3	2	–
Engineering Thermodynamics..	435, 423	–	–	2	3
Industrial Management.......	320, 322	2	3	2	3
Industrial Psychology.........	327	–	–	2	–
Modern World History........	324	2	–	2	–
Numerical Analysis...........	514, 515	2	3	2	3
Practical Experience..........	690	–	–	–	–

Fourth Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Elementary Control Theory	480, 481	2	3	2	3
Electric Machines	342, 343	2	3	–	–
Engineering Data Processing	678, 679	–	–	2	3
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Industrial Management (Session 1962–63 only)	320, 322	2	3	2	3
Machine Design (commencing 1963–64)	482, 468	2	3	2	3
Manufacturing Process Dynamics	476, 477	–	–	2	3
Operations Research I	524, 525	2	3	2	3
Operations Research II	526, 527	2	3	–	–
Philosophy of Science	326	2	–	–	–
Practical Experience	690	–	–	–	–
Thesis	730	–	2	–	2

ENGINEERING SCIENCE

(ENGINEERING PHYSICS)

(Course 5)

The Course in "Engineering Physics" was established in 1934 "to afford a training in mathematics and physics beyond that which it is possible to give in the other undergraduate courses in engineering". Originally the options offered in the Third and Fouth Years were related to the physical sciences and the name of the course, Engineering Physics, was appropriate.

In 1958 a Chemical Option was added on the same basis, i.e. in Third and Fourth Years.

Commencing in the session 1962–63 the scope of the course is to be broadened to include, more adequately than in the past, an option (or options) related to the chemical sciences. The name of the course therefore is to be changed to "Engineering Science" commencing with the class graduating in 1965.

The purpose of the course is not changed. It is designed for those, who, having a definite flair for mathematics and science, anticipate proceeding to post-graduate study and an occupation in the fields of research and development or teaching.

In the Second Year the student may select one of two programmes, differing by about 4 hours per week, which provide slightly greater emphasis either on the physical or the chemical sciences.

The options offered in the Third and Fourth Years cater to a variety of specific interests and prepare the student for post-graduate work in many of the Engineering Departments or in Physics, Biophysics or Applied Mathematics.

Admission to this course is granted only to those students who, having met the general admission requirements set forth on page 20 of this Calendar, obtain an average of 70% on the nine specified papers of Grade XIII, or the equivalent in other school systems.

Promotion to the Second Year of the Engineering Science course is granted only to those students who, in addition to meeting the regular requirements, obtain a weighted average of not less than 66% on the examinations of the First Year. Students who obtain a weighted average of 60% or over in the First Year of this course, and who have met all the regular requirements, will be permitted to proceed to the Second Year of any course in the Faculty, other than Engineering Science, without condition. Permission to repeat the First Year of the course in Engineering Science must be sought by petition to the Council of the Faculty.

The subjects of instruction are shown in the following tables and are more fully described according to subject reference numbers, page 65 to 124.

For FIRST YEAR CURRICULUM—DIVISION C, see page 33.

Students are required to state at the beginning of the Second Year which elective they intend to choose, and at the beginning of the Third Year which option they intend to pursue. Council retains the right to withhold an option if the number of students offering or conditions existing at the time render it impracticable to give the work.

Second Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Calculus	504	2	–	2	–
Economics	311	2	–	2	–
Electric Circuits	354, 356	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Integral Calculus and Differential Equations	505	2	–	2	–
Mathematical Problems	495	–	3	–	3
Physical Chemistry	238, 262	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Physics	652, 655	3	3	3	3
Probability and Numerical Methods	501	2	–	2	–
And either of the following groups of subjects:					
Dynamics	25	2	–	–	–
Mechanics of Materials	24, 31	–	–	2	3
or					
Inorganic Chemistry	237	2	–	2	–
Chemical Engineering Science Laboratory	263	–	–	–	3

Third Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Advanced Mechanics	27	2	–	2	–
Differential Equations	509	2	–	2	–
Modern World History	324	2	–	2	–
Physics Laboratory	659	–	3	–	3
Thermodynamics and Kinetic Theory	657	2	–	2	–
Theory of Functions	508	1	1	1	1

And *one* of the following options which must be continued in the Fourth Year.

Option 5a, Aeronautics/ Astronautics					
Electronics	347, 348	2	–	2	1½
Mechanics of Solids and Structures	7, 8	2	3	2	3
Fluid Mechanics	12, 15	2	3	2	3
Physical Metallurgy	561	1	–	1	–
Option 5c, Chemical					
Chemical Theory B	240	2	–	2	–
Chemical Laboratory	249	–	6	–	6
Crystallography	390	1	–	1	–
Electronics	347, 348	2	–	2	1½
Fluid Mechanics	12, 15	2	3	2	3
Physical Metallurgy	561	1	–	1	–
Option 5e, Electrical					
Circuit Analysis	350	2	–	2	–
Electrical Machines	372, 374	2	1½	2	1½
Electronics	366, 379	2	–	2	3
Physical Metallurgy	566, 567	–	–	2	1½
Physics of Solids and Fluids	656	1	–	1	–
Option 5g, Geophysics					
Electronics	347, 348	2	–	2	1½
Physical Geology	380, 381, 413	–	3	–	–
Mineralogy and Lithology	386, 387	2	2	2	2
Physical Metallurgy	561	1	–	1	–
Physics of Solids and Fluids	656	1	–	1	–
Physics of the Earth	674	1	–	1	–
Structural Geology	397, 398	1	3	1	3
Option 5m, Physical Metallurgy					
Crystallography	390	1	–	1	–
Electronics	366, 379	2	–	2	3
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	533, 534	2	3	2	3
Physics of Solids and Fluids	656	1	–	1	–
Option 5n, Nuclear					
Atomic Structure and Quantum Physics	660	2	–	2	–
Electronics	347, 348	2	–	2	1½
Machine Design	471, 472	1	3	1	3
Nuclear Physics	662	1	–	1	–
Fluid Mechanics	12, 15	2	3	2	3
Option 5p, Physics					
Atomic Structure and Quantum Physics	660	2	–	2	–
Crystallography	390	1	–	1	–
Electronics	366, 379	2	–	2	3
Machine Design	471, 472	1	3	1	3
Physics of Solids and Fluids	656	1	–	1	–

Third Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5t, Thermodynamics					
Electronics	347, 348	2	–	2	$1\frac{1}{2}$
Fluid Mechanics	12, 15	2	3	2	3
Heat Engineering	438, 423	2	3	2	3
Machine Design	471, 472	1	3	1	3
Physical Metallurgy	561	1	–	1	–

Fourth Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5a, Aeronautics/ Astronautics					
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Engineering Design	3, 4	2	3	2	3
English	611	1	–	1	–
Gasdynamics	13, 16	2	$1\frac{1}{2}$	1	3
Mechanics of Solids and Structures	5, 6	2	3	2	3
Philosophy of Science	326	2	–	–	–
Plasmadynamics	9, 10	1	–	2	$1\frac{1}{2}$
Thesis	730	–	–	–	–
Transport Phenomena	1	1	–	1	–
Option 5c, Chemical					
Atomic Physics	663	3	–	3	–
Chem. Eng. Laboratory	252	–	6	–	9
Chem. Eng. Thermodynamics and Kinetics	256	2	–	2	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Mass Transfer Operations	253	2	–	2	–
English	611	1	–	1	–
Organic Chemistry	250, 258	2	3	2	–
Philosophy of Science	326	2	–	–	–
Physics Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5e, Electrical					
Atomic Physics	663	3	–	3	–
Circuit Analysis	350	2	–	2	–
Communications I	360, 361	3	3	–	–
Communications II	362, 363	–	–	3	3
Communications III	371	–	–	2	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Control Systems	358, 359	2	1½	2	1½
English	611	1	–	1	–
Electromagnetic Theory, Applied	365	2	–	2	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	–	–	–
Option 5g, Geophysics					
Atomic Physics	663	3	–	3	
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Geophysical Methods	670, 672	2	6	2	6
Mineral Deposits	399	2	–	2	–
Petroleum Geology	407, 408	2	–	2	3
Philosophy of Science	326	2	–	–	–
Physics of the Earth	675	–	–	2	–
Precambrian Geology	403, 404	2	1	–	–
Thesis	730	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5m, Physical Metallurgy					
Atomic Physics	663	3	–	3	–
Communications I	360, 361	3	3	–	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Metal Physics Seminar	563	–	3	–	3
Operational Methods	364	2	–	2	–
Physical Metallurgy	557, 562	2	–	2	3
Philosophy of Science	326	2	–	–	–
Physics Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–
X-Ray Crystallography	415	2	–	–	–
Option 5n, Nuclear					
Atomic Physics	663	3	–	3	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Control Systems	358, 359	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Gasdynamics	13, 16	2	$1\frac{1}{2}$	1	3
Heat Transfer	433	–	–	2	–
Nuclear Engineering	664	1	–	1	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Physics Laboratory	665	–	6	–	6
Thesis	730	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5p, Physics					
Atomic Physics	663	3	–	3	–
Communications I	360, 361	3	3	–	–
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	365	2	–	2	–
English	611	1	–	1	–
Operational Methods	364	2	–	2	–
Optics II	666	2	–	2	–
Philosophy of Science	326	2	–	–	–
Physics Laboratory	665	–	9	–	9
Quantum Mechanics	669	1	–	1	–
Thesis	730	–	–	–	–
Option 5t, Thermodynamics					
Atomic Physics	663	3	–	3	–
Computational Methods	522	1	3	–	–
Differential Equations of Mathematical Physics	521	2	–	2	–
English	611	1	–	1	–
Gasdynamics	13, 16	2	1½	1	3
Heat Engineering Laboratory	426	–	3	–	3
Heat Power Engineering	430	1	–	1	–
Heat Transfer	433	–	–	2	–
Refrigeration and Air Conditioning	429	2	–	–	–
Internal Combustion	436	1	–	1	–
Machine Design	478	–	–	2	–
Operational Methods	364	2	–	2	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	–	–	–
Vibration Engineering	99, 100	–	–	2	3

CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(Course 6)

The chemical engineer is concerned with the development and operation of processes by means of which matter is chemically altered to a more useful form, and in the design, construction, operation and management of plant in which to effect such changes. Apart from such obviously chemical processes as those concerned with the production of acids, alkalis, salts, petroleum, rubber products, pulp and paper, explosives, paints and varnishes, soap, plastics, etc., there are many industrial processes where chemistry plays a part, or where a knowledge of chemistry is valuable. There is thus a wide field of endeavour for the chemical engineer. In order to equip a student to enter this field, the course in chemical engineering is intended to provide the student with training in the principles of the major divisions of chemistry and chemical engineering, together with an understanding of such other engineering subjects as thermodynamics, hydraulics, electricity, mechanics of materials, and machine design.

As part of the work of the Fourth Year each student is assigned a problem involving original investigation, in order to let him apply to some extent what he has learned, and to introduce him to the chemical literature. It also serves as an introduction to research for those who are attracted to it, and who, because of their basic training are equipped to carry on research in chemistry or chemical engineering at the graduate level or in laboratories outside the university.

For those students considering taking up the teaching of science as a profession, the nature and extent of the thesis subject in the Fourth Year may be modified to allow the student to take such other instruction as may be necessary to shorten the time required before becoming professionally qualified.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	232, 233	2	9	–	–
Analytical Chemistry Laboratory	229	–	–	–	–
Calculus	491, 287	2	1½	2	1½
Chemical Engineering Science Laboratory	235	–	–	–	12
Economics	311	2	–	2	–
Electrical Engineering	375, 376	2	3	2	3
Industrial Chemistry	230	2	–	1	–
Inorganic Chemistry	231	1	–	2	–
Mechanics of Materials	23	2	–	2	–
Organic Chemistry	234	1	–	2	–
Physical Chemistry	236	2	–	2	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory	249	–	6	–	6
Chemical Theory A	239	1	–	1	–
Chemical Theory B	240	2	–	2	–
Differential Equations	507	1	–	1	–
Fluid Mechanics	452, 453	2	3	–	–
Engineering Thermodynamics	431, 423	2	–	–	3
Industrial Chemistry	241	–	–	3	–
Introduction to Mass and Heat Transfer	242	2	–	2	3
Modern World History	324	2	–	2	–
Organic Chemistry	244, 245	2	9	2	6
Practical Experience	690	–	–	–	–
Public Speaking	319	–	1	–	1

Fourth Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Chemical Engineering	255	–	3	–	–
Chemical Engineering Thermodynamics and Kinetics	256	2	–	2	–
Chemical Engineering Laboratory	251	–	10	–	–
Chemical Plant Design	254	1	–	–	3
Electrochemistry	246, 247	2	$1\frac{1}{2}$	–	–
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Industrial Management	315	1	–	–	–
Machine Design	479, 470	2	–	1	3
Mass Transfer Operations	253	2	–	2	–
Organic Chemistry	257	1	–	1	–
Philosophy of Science	326	2	–	–	–
Thesis	730	–	3	–	18

ELECTRICAL ENGINEERING

(Course 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields in addition to that of applying things electrical for the benefit of humanity. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also heat engines, hydraulics, theory of mechanisms, machine design, business, economics, engineering law, and other non-electrical subjects.

In the electrical field much time is given to the calculation of circuits of electric, magnetic, and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets, and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial, or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Physics	70, 71	–	–	2	3
Chemistry	225	2	–	–	–
Calculus and Differential Equations	493	2	2	2	2
Dynamics	26, 32	2	1½	1	1½
Economics	311	2	–	2	–
Electric Circuits I	332	3		3	
Electric and Magnetic Fields	333	2	2	2	2
Electrical Measurements	340	–	–	2	–
Electrical Laboratory	334	–	3	–	3
Mechanics of Materials	33, 31	2	3	1	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics	336	2	2	2	2
Business	310	–	–	1	–
Electric Circuits II	341	3	–	3	–
Electric Machinery I	339	2	–	1	–
Electronics	337	2	–	3	–
Electrical Problems	335	–	4	–	4
Electrical Laboratory	344	–	3	–	3
Electronics Laboratory	379	–	–	–	3
Heat Engineering Laboratory	423	–	3	–	–
Machine Design	475, 468	2	3	–	–
Modern World History	324	2	–	2	–
Physical Metallurgy	566, 567	–	–	2	$1\frac{1}{2}$
Practical Experience	690	–	–	–	–
Thermodynamics	437	2	–	1	–

Fourth Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Electronic Circuits	360, 361	3	3	–	–
Electronic Machinery II	353, 355	3	3	–	–
Control Systems	357, 359	2	1½	2	1½
Electromagnetic Engineering	352	2	1	2	1
Engineering Law	314	1	–	–	–
English	611	1	–	1	–
Fluid Mechanics		–	–	3	3
Industrial Management	315	1	–	–	–
Philosophy of Science	326	2	–	–	–
Thesis		–	1	–	1
And one of the following groups of subjects:					
Group A					
Acoustics	82, 83	–	–	2	1½
Communication Systems	362, 363	–	–	3	3
High-Frequency Electronics	371	–	–	2	
Group B					
Electric Machinery III	369, 370	–	–	2	1½
Electric Power Systems	373	–	–	2	2
Illumination	93, 94	–	–	2	3

METALLURGICAL ENGINEERING

(Course 8)

No other materials approach the metals in strength, and the whole fabric of modern civilization is dependent on their properties. The fields of employment for graduates lie in production metallurgical industries, the industries which fabricate metals, and in sales and research. Metallurgical research facilities have notably been increased in recent years in Canada.

The metallurgical engineer is concerned with the winning of metals from ores. Since virgin metals rarely possess useful physical properties, the second task of the metallurgist is to produce alloys, such as steel, which have suitable physical properties.

Both physical and extractive metallurgy are based upon the sciences of chemistry and physics. It is believed that a wider knowledge of the basic sciences will bring to the student a readier appreciation of the technical problems with which he will be later confronted and a greater facility in their solution. To achieve this end, greater emphasis is placed upon physics and chemistry in the earlier years of the course. It follows that this course will be of greater value to students who have obtained a good standing in mathematics and science. In addition to instruction in extractive and physical metallurgy, engineering subjects are provided to give a general knowledge of mechanics of materials, machine design, etc. The course includes the non-technical subjects, such as Economics and English, which are common to all courses in the Faculty.

Courses in production metallurgy cover the theory and practice of winning aluminium, copper, iron, lead, magnesium, nickel, zinc, etc., from their ores. Physical Metallurgy courses cover the structure and properties of alloys, including microscopic, x-rays and mechanical methods of investigation.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	228	–	4	–	4
Calculus	491	2	–	2	–
Economics	311	2	–	2	–
Electrical Engineering	375, 376	2	3	2	3
Engineering Problems and Drawing	289	–	3	–	3
Inorganic Chemistry	231	1	–	2	–
Mechanics of Materials	23, 31	2	3	2	–
Metallurgy	530	2	–	2	–
Metallurgy Problems	540	–	–	–	2
Optics	72, 73	1	3	1	3
Physical Chemistry	236	2	–	2	–
Practical Experience	690	–	–	–	–

Third Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 164	1	3	1	–
Crystallography	390	1	–	1	–
Differential Equations	507	1	–	1	–
Fluid Mechanics	452	2	–	–	–
Metallurgical Problems Laboratory	536	–	4	–	4
Metallurgical Thermodynamics I	535	2	–	2	–
Mineral Dressing	180, 181	2	–	2	6
Modern World History	324	2	–	2	–
Practical Experience	690	–	–	–	–
Principles of Extractive Metallurgy	531, 532	2	3	2	6
Principles of Physical Metallurgy	533, 534	2	3	2	3

Fourth Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Extractive Metallurgy Laboratory	552	–	6	–	–
Ferrous Extractive Metallurgy	551	1	–	1	–
Fluid Mechanics	452	2	–	–	–
Heat Transfer	432	–	–	2	–
Machine Design	469, 470	1	–	1	3
Metallurgical Thermodynamics II	553	2	–	2	–
Metallurgical Problems Laboratory	554	–	2	–	2
Non-Ferrous Extractive Metallurgy	550	1	–	1	–
Ore Dressing	183	1	–	1	–
Philosophy of Science	326	2	–	–	–
Physical Metallurgy	557, 558	2	6	2	3
Practical Experience	690	–	–	–	–
Statistics	510	2	–	–	–
Thesis	730	–	3	–	12

APPLIED GEOLOGY

(Course 9)

The expanding Canadian economy is making ever growing demands on the Mineral Industry for raw products—iron, copper, uranium, gas, petroleum, etc. Geologists play an important part in this industry. They belong to a team—whose other members are mining engineers and metallurgists—responsible for finding new deposits of metals, mining them, and extracting the metals from the ores. In addition, geologists are widely employed in the petroleum industry.

The course in Applied Geology provides a training in the fundamentals of the geological sciences and graduates in this course are suitably trained to enter the ranks of professional geologists. Students also take work with related departments, such as Mining Engineering, Metallurgical Engineering, Chemical Engineering and Civil Engineering, and in this way have some knowledge of other fields of engineering.

The geological subjects are selected so that they will carry the student through from an introductory course to a stage where he has a useful knowledge of the broad field of the subject. He is properly trained to find employment in mining geology, petroleum geology, or engineering geology. Such work may be with exploration companies, oil companies or mining companies.

Graduates in Applied Geology who wish further specialized training in geology may proceed to the M.A.Sc. or Ph.D. degrees, and thus qualify themselves for employment with government geological surveys or as university teachers.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, *e.g.*, Economics, 311, page 87.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	227	–	6	–	–
Calculus	491, 287	2	1½	2	1½
Chemistry	224	2	–	–	–
Economics	311	2	–	2	–
Historical and Stratigraphical Geology	393, 394	–	–	2	3
Mechanics of Materials	23, 31	2	–	2	3
Mineralogy and Lithology	386, 387	2	2	2	2
Mining	165	–	–	1	2
Optics	72, 73	1	3	1	3
Oral Expression	193	–	–	–	2
Physical Geology	380, 381	2	3	–	–
Practical Experience	690	–	–	–	–
Surveying	715, 717	1	3	2	2

Third Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	160, 161	1	3	1	3
Business	310	–	–	1	–
Descriptive Mineralogy	388	–	2	–	2
Elementary Geochemistry	385	2	–	2	–
Geological Field Work	411	–	–	–	–
Metallurgy	539	–	–	1	–
Mineral Dressing	186	2	–	–	–
Mining	168	3	–	–	–
Modern World History	324	2	–	2	–
Ore Microscopy	389	–	–	–	3
Palaeontology	395, 396	2	2	2	2
Petrology	391, 392	3	2	2	2
Practical Experience	690	–	–	–	–
Stratigraphy and Sedimentation	409, 410	2	–	–	2
Structural Geology	397, 398	1	3	1	3
Survey Camp	720	–	–	–	–

Fourth Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	611	1	–	1	–
Geology of Canada	401	1	–	1	–
Geological Field Trips	412, 414	–	–	–	–
Geophysics	671, 673	1	3	1	3
Metallurgy	555	1	–	1	–
Mineral Deposits	399, 400	2	–	2	3
Mine Operation and Administration	170, 173	2	–	2	3
Mining Geology	405, 406	–	3	2	–
Petroleum Geology	407, 408	2	–	2	3
Pleistocene Geology	402	2	–	2	–
Practical Experience	690	–	–	–	–
Precambrian Geology	403, 404	2	3	–	3
Philosophy of Science	326	2	–	–	–
Thesis	730	–	6	–	–

AERONAUTICAL/ASTRONAUTICAL ENGINEERING

A five year program of study has been designed to prepare the student for a career in aeronautical/astronautical engineering. It includes the following elements: (a) an introduction to the fundamentals of mathematics, physics, and chemistry, (b) an introduction to aerodynamics, instrumentation, propulsion, structures and design, and (c) an advanced treatment of the subjects required for modern design and research in aeronautics/astronautics such as hypersonic aerodynamics, flight dynamics, and space propulsion. Under (a) and (b) the student's training is necessarily broad and basic. The more advanced knowledge needed for the research, development, and design relevant to new aircraft and spacecraft is provided under (c) and is of particular significance. It is possible to provide (a) and (b) in a four-year undergraduate course, but the final intensive training under (c) must be left for a graduate year.

The program of study that leads to status as a well-qualified aeronautical/astronautical engineer has been established in two parts as follows:

(i) *Undergraduate Course.* The student registers in the course in Engineering Science, subject to the entrance requirements given on page 20 of this Calendar. This course provides the requisite training in the fundamental sciences (see (*a*) above). The advanced subjects contained in the Aeronautics/Astronautics option given in the third and fourth years are taught by the staff of the Institute of Aerophysics (see (*b*) above). The student will receive the degree of Bachelor of Applied Science upon completion of this part of the program.

(ii) *Graduate Course.* The student will then continue his five year program (*see* (*c*) above) in the Department of Aeronautical Engineering and Aerophysics, School of Graduate Studies, as a candidate for the degree of Master of Applied Science in Aeronautical/Astronautical Engineering. During this year the student has a choice of taking one of two options consisting of at least four courses and a review thesis or at least two courses and a research or development thesis. Details regarding entrance regulations and courses of study are given in the Calendar of the School of Graduate Studies. The facilities of the Institute of Aerophysics are available to the student. For details of research projects, assistantships, scholarships and demonstratorships, students should consult the Director of the Institute of Aerophysics.

It should be noted that a student who has graduated in another branch of engineering and who desires to qualify as an aeronautical/astronautical engineer may proceed directly with (ii) above, but in this case the course leading to the M.A.Sc. degree must be arranged so that deficiencies in his undergraduate training are made up.

The facilities of the Institute of Aerophysics are available for further graduate study leading to the Ph.D. Degree.

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 221, Chemistry, means the course of lectures indicated by this number in the table of curriculum for the First Year on page 32.

Where laboratory reports are to be written outside of assigned laboratory hours, the maximum number of such reports is indicated in the description of the laboratory course concerned.

INSTITUTE OF AEROPHYSICS

1. Transport Phenomena. B. Etkin.

Course 5a, IV year: 1 hr. lecture per week, both terms.

A fundamental treatment of selected phenomena in fluid dynamics in which the transport of momentum, mass and energy are the key underlying processes, i.e. dynamics of viscous fluids; boundary layers; turbulence; diffusion.

Reference book: Transport Phenomena—Bird, Stewart and Lightfoot.

3. Engineering Design. R. D. Hiscocks.

Course 5a, IV Year; 2 hrs. lectures per week, both terms.

An introduction to the principles of design; the origin of a design requirement; loading, performance and other criteria; typical design specifications.

The process is examined by which the design is synthesized from the design specification and various other related data.

Selection of material; type of structure and fabrication technique.

Certain important aspects of design are examined in detail. These include the design of riveted, bolted, glued and welded joints, the design of cast and forged structural components, the fatigue life of structures and "fail safe" principles.

The course is illustrated throughout by reference to typical design problems, some of which are solved by the students.

4. Engineering Design Laboratory. R. D. Hiscocks.

Course 5a, IV year; 3 hrs. laboratory per week, both terms.

Design projects based on the lectures in subject 3 are assigned. Design drawings, and engineering reports are prepared by the students.

5. Mechanics of Solids and Structures. E. D. Poppleton.

Course 5a, IV year; 2 hrs. lectures per week, both terms.

A continuation of subject 7 to a more advanced level; structural stability; thermal stresses; structural vibrations and wave propagation.

Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

6. Mechanics of Solids and Structures Laboratory. E. D. Poppleton.
Course 5a, IV year; 3 hrs. laboratory per week, both terms.
Problems and experiments related to subject 5.
Eight laboratory reports.

7. Mechanics of Solids and Structures. E. D. Poppleton.
Course 5a, III year; 2 hrs. lectures per week, both terms.
A discussion of the structure of solids and the mechanics of their deformation. An introduction to the classical theories of elasticity and plasticity with application to the analysis of simple structures.
Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

8. Mechanics of Solids and Structures Laboratory. E. D. Poppleton.
Course 5a, III year; 3 hrs. laboratory per week, both terms.
Problems and experiments related to subject 7.
Four laboratory reports.

9. Plasmadynamics. J. H. de Leeuw.
Course 5a, IV year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
Review of electric and magnetic fields. Derivation of Maxwell's equations. Thermodynamics and equations of motion of an electrically conductive medium. Simple examples of the influence of a magnetic field on the motion of an electrically conductive medium.

10. Plasmadynamics Laboratory. J. H. de Leeuw, J. B. French.
Course 5a, IV Year; 3 hrs. laboratory alternate weeks, second term.
Problems and experiments based on the lecture material of subject 9.
Two laboratory reports.

12. Fluid Mechanics. G. K. Korbacher, W. D. Baines, L. E. Jones.
Courses 5a, 5c, 5n, 5t, III Year; 2 hrs. lectures per week, both terms.
Introductory concepts; vector analysis; inviscid flow, incompressible and compressible; viscous flow and turbulence; similitude and models; conduit systems; gravity effects; fluid machinery.

13. Gasdynamics. I. I. Glass.
Courses 5a, 5n and 5t, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
Introductory thermodynamics of perfect and imperfect gases, equations of motion and their application to nozzles, diffusers and supersonic wind tunnels; expansion waves; normal, oblique and conical shock waves; skin friction and heat transfer in boundary layers and ducts; aerodynamic measurements.

Reference books: Elements of Gasdynamics—Liepmann and Roshko. Dynamics and Thermodynamics of Compressible Fluid Flow—Shapiro. An Introduction to Fluid Mechanics and Heat Transfer—Kay.

15. Fluid Mechanics Laboratory. G. K. Korbacher, B. Etkin, J. B. French, L. E. Jones, W. D. Baines.

Courses 5a, 5c, 5n, 5t, III Year; 3 hrs. laboratory per week, both terms.

Problems and experiments related to subject 12.

16. Gasdynamics Laboratory. I. I. Glass, J. B. French.

Courses 5a, 5n and 5t, IV Year; 3 hrs. laboratory alternate weeks. first term; 3 hrs. laboratory per week, second term.

Problems and experiments based on subject 13 are given to illustrate principles of gas dynamics and the measurement of physical quantities.

Six laboratory reports.

APPLIED MECHANICS AND DESIGN OF STRUCTURES

20. Applied Mechanics. C. F. Morrison, M. W. Huggins, A. C. Davidson, B. Goodal, K. Meipoom, R. G. Tress, J. Timusk, S. M. Uzumeri, G. T. Will.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

This subject is divided into two parts, statics and dynamics.

Statics: The principles of statics are discussed, and appplied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and the bending moments and shearing forces in beams.

Dynamics: Theoretical principles and practical applications are discussed for:

Particle motion on straight and curved paths; work, energy and power; impulse and momentum; plane translation and rotation of rigid bodies.

Text Book: Engineering Mechanics—Higdon and Stiles (Second Edition).

21. Statics. R. A. Collins, J. D. Barber.

Course 5, I Year; 2 hrs. lectures per week, first term.

The principles of statics are discussed, and applied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and the bending moments and shearing forces in beams.

22. Dynamics. G. E. Godfrey.

Courses 1 and 4, II Year; 2 hrs. lectures per week, second term.

Motion of a point is reviewed and extended to include Coriolis' acceleration, with applications. Equations for motion of mass in translation, rotation, and plane motion are developed, including centre of percussion. Moment of inertia of mass is studied by

double integration and by the lamina method. The derivation and application of gyroscopic action is thoroughly discussed, and an introduction to static and dynamic balancing is given. Elementary vibration theory and problems in vibration isolation are discussed.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics—Part II—Meriam.

23. Mechanics of Materials. J. D. Barber, E. Karuks, K. Meipoom.

Courses 2, 4, 6, 8, and 9, II Year; 2 hrs. lectures per week, both terms.

In this subject, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pressure vessels, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Text book: Mechanics of Materials—Higdon, Ohlsen and Stiles.

24. Mechanics of Materials. R. A. Collins.

Course 5, II Year (elective); 2 hrs. lectures per week, second term.

Basic relationships between force, stress, strain, and deflection of bodies made of various engineering materials are discussed. Beams, columns, shafts, tension members and pressure vessels are analysed and designed for strength and stiffness.

Text book: Mechanics of Materials—Popov.

25. Dynamics. F. C. Hooper.

Course 5, II Year (elective); 2 hrs. lectures per week, first term.

Simple particle motion. Work and energy. Impulse and momentum. Kinematics of plane motion and Coriolis acceleration. Kinetics of translation and rotation. General kinetics of plane motion. Gyroscopic action. Simple vibrations. Gibbs' Vector Notation.

Reference books: Engineering Dynamics—Hooper and Smith. Mechanics—Part II Dynamics—Meriam.

26. Dynamics. F. P. J. Rimrott.

Course 7, II Year; 2 hrs. lectures per week first term; 1 hr. lecture per week, second term.

Motion of a point, including Coriolis' acceleration; motion of mass; gyroscopic action; vibration and balancing; electro-mechanical analogies; Gibb's vector notation.

Text book: Engineering Dynamics—Hooper and Smith.

Reference books: Part II—Meriam. Engineering Mechanics—Shames.

27. Advanced Mechanics. H. S. Ribner.

Course 5, III Year; 2 hrs. lectures per week, both terms.

Mechanics of particles: fixed axes, rotating and moving axes, rectilinear motion of rockets, orbital dynamics. Mechanics of rigid bodies: fixed axes, body-attached axes (Euler's equations), gyroscopes. Dynamics of linear systems: free and forced oscillations, coupled systems, waves on a string, Rayleigh's method for

continuous systems. Lagrange's equations. Introduction to wave mechanics.

Reference books: Introduction to Theoretical Physics—Page. Principles of Mechanics—Synge & Griffith.

28. Structural Design I. M. W. Huggins.

Course 1A, III Year; 2 hrs. lectures per week, both terms.

An elementary study of the stress analysis and design of structures, structural members, and their details. Problems in analysis and design are worked out in the lectures and in the drafting room.

The work covered includes static and moving loads, steel and timber tension members, compression members and flexural members including box-girders, plate girders and continuous as well as simple span beams. Welding as a method of connecting structural steel members is studied.

Text books: Design of Steel Structures—Gaylord and Gaylord. Structural Problems—Young and Morrison. Steel Construction Handbook—A.I.S.C.

29. Elementary Structural Engineering. A. C. Davidson.

Courses 2 and 4, III Year; 1 hr. lecture per week first term; 2 hrs. lectures per week, second term.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject No. 53).

Text books: Design of Steel Structures—Gaylord & Gaylord. Steel Construction Manual—American Institute of Steel Construction. National Building Code of Canada—National Research Council, Ottawa. Timber Construction Manual—Canadian Institute of Timber Construction. Basic Reinforced Concrete Design—Large.

30. Structural Engineering. J. D. Barber.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject 52).

The work covered comprises: Moving loads in simply supported beams; in steel, tension and compression member details, columns, rolled steel beams, built-up beams and girders; in wood, beams, columns, and their connections; in concrete, the making of plain concrete, reinforced concrete beams, columns, slabs and footings.

Text books: Design of Steel Structures—Gaylord & Gaylord. Steel Construction Manual—American Institute of Steel Construction. National Building Code of Canada—National Research Council, Ottawa. Timber Construction Manual—Canadian Institute of Timber Construction. Basic Reinforced Concrete Design—Large.

31. Mechanics of Materials: General. W. L. Sagar, C. E. Helwig, C. W. Dillane, J. D. Barber, R. G. Tress.

Courses 1, 2, and 9, II Year; 3 hrs. laboratory per week, second term.

Course 5, II Year (elective); 3 hrs. laboratory per week, second term.

Courses 3, 4, 7, and 8, II Year; 3 hrs. laboratory per week, first term.

An introduction to testing machines, strain and other measuring devices and standard specifications.

The experimental study of some engineering materials and structural members under external load.

No laboratory report shall be written outside the assigned teaching hours.

32. Dynamics Laboratory. F. P. J. Rimrott.

Course 7, II Year; 1½ hrs. problems per week, both terms.

Problems in kinematics and kinetics to support subject 26.

33. Mechanics of Materials. A. C. Davidson.

Course 7, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The fundamental relations among stress, strain and applied load are worked out for tension, compression, twisting and bending in the elastic and inelastic ranges, for various engineering materials. Buckling phenomena are examined for struts and columns. Numerical applications are done in lectures; and problems are assigned for study.

Text: Mechanics of Materials—Popov.

34. Mechanics of Materials. D. J. L. Kennedy, S. M. Uzumeri.

Courses 1 and 3, II Year; 2 hrs. lectures per week, both terms.

An introduction to the elastic and inelastic behaviour of solids under various external loading conditions. Strains, stresses and deformations are determined for members subjected to tension, compression, torsion and bending and for pressure vessels by using basic strength of materials theories.

Text: Mechanics of Materials—Popov.

36. Theory of Structures. C. F. Morrison.

Course 1A, IV Year; 2 hrs. lectures per week, both terms (1962–63 only).

The stress analysis of simple span, continuous, and cantilever trusses. Influence lines and index stresses. Truss deflections by analytical and graphical methods. Arches, suspension bridges, and statically indeterminate structures.

Text books: Theory of Simple Structures—Shedd and Vawter. Structural Theory—Sutherland and Bowman.

37. Theory of Structures: Problems. C. F. Morrison, R. A. Collins, A. C. Davidson, S. M. Uzumeri, G. T. Will.

Course 1A, IV Year; 1½ hrs. laboratory work per week, both terms (1962–63 only).

Problems are worked out in the laboratory following the lecture course 36. Reports written outside the laboratory period are not accepted.

38. Mechanics of Materials. General. W. L. Sagar, C. E. Helwig, C. W. Dillane, J. D. Barber, K. Meipoom, R. G. Tress.

Course 1A, IV Year; 3 hrs. laboratory per week, both terms (1962–63 only).

The behaviour of various engineering materials under load. Verification of testing machines. The use of precision instruments in the determination of stress-strain relationships. A study of reinforced concrete beams in flexure and shear. The behaviour of some typical structural units under load. Non-destructive tests.

No laboratory report shall be written outside the assigned teaching hours.

39. Soil Mechanics. W. L. Sagar, F. A. De Lory.

Course 1, III Year; 2 hrs. lectures per week first term.

Identification and classification of soils for engineering purposes; weight volume relationships, compaction; permeability and drainage characteristics; consolidation; field exploration and sampling; stress-deformation characteristics; shearing strength.

Reference Books: Foundation Engineering—Peck, Hanson and Thornburn. Introductory Soil Mechanics and Foundations—Sowers and Sowers.

40. Soil Mechanics and Foundations. W. L. Sagar.

Course 1A, IV Year; 2 hrs. lectures per week, both terms (1962–63 only).

An introduction to the physical and mechanical properties of soil that govern its behaviour as an engineering material. The studies include sub-soil exploration, soil classification, moisture-density relations, shear strength, permeability, consolidation, frost action, and soil structure.

The foundation section deals with earth pressures and stress distribution in soils, bearing capacities, stability of slopes, retaining walls, cofferdams and caissons, pile and other foundations.

Reference books: Foundation Engineering—Peck, Hanson, Thornburn. Introductory Soil Mechanics and Foundations—Sowers & Sowers. Basic Soils Engineering—Hough.

41. Reinforced Concrete. M. W. Huggins.

Course 1, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term. (1962–63 only).

The theory of design of reinforced concrete elements including the beam, the slab, the T-beam, the column and the girderless floor, is continued in this course.

In addition the course provides an introduction to the design of prestressed concrete.

The student is required in the drafting room to apply his knowledge to the design of simple structures.

Text book: Reinforced Concrete Fundamentals—Ferguson.

Reference books: Theory & Practice of Reinforced Concrete—Dunham. Reinforced Concrete Design—Sutherland and Reese.

42. Reinforced Concrete Problems. M. W. Huggins, R. A. Collins, A. C. Davidson, S. M. Uzumeri, G. T. Will.

Course 1, IV Year; 1½ hrs. laboratory per week, both terms (1962–63 only).

Problems supplementing lecture course 41 are worked out in the laboratory. Reports written outside the laboratory period are not accepted.

43. Structural Design. M. W. Huggins.

Course 1A, IV Year; 1 hr. lecture per week, both terms (1962–63 only).

Consideration is given to the various types of industrial buildings and other structures, the conditions governing their choice and the design and details of construction in different materials. Examples in design are worked out in the class and drafting rooms illustrating such points as: economic arrangement of building frames, probable loadings for girders and columns, column eccentricities, wind loading, wind bracing, rigid frames, and crane runways.

Reference books: Design of Steel Structures—Gaylord & Gaylord. Structural Problems—Young and Morrison. Theory of Modern Steel Structures—Grinter.

45. Soils & Highway Laboratory. W. L. Sagar, M. M. Davis, C. E. Helwig, F. A. De Lory, C. W. Dillane, J. D. Barber, R. G. Tress.

Course 1, III Year; 3 hrs. per week, first term.

A series of laboratory and problem periods to accompany courses in Soil Mechanics (39) and Highway Engineering (209).

46. Structural Engineering I. G. T. Will.

Course 1B, III Year; 2 hrs. lectures per week, both terms.

An introduction to the analysis of indeterminate structures and the design of metal and timber load carrying members and their connections. Problems are worked in class and in the drafting room (Subject No. 47).

Text Books: Theory of Simple Structures—Shedd and Vawter. Design of Steel Structures—Gaylord and Gaylord.

47. Structural Engineering I Problems. C. Hershfield, G. T. Will, E. Karuks.

Course 1B, III Year; 1½ hrs. per week, first term; 3 hrs. per week, second term.

Problems supplementing the work covered in lecture course 46 are assigned and worked out in the drafting room.

49. Soil Mechanics and Foundations. W. L. Sagar.

Course 1B, IV Year; 1 hr. lecture per week, both terms (1962–63 only).

An abridgement of the work covered in subject 40.

50. Mechanics of Materials: Soils and Highway. W. L. Sagar, C. E. Helwig, F. A. De Lory, C. W. Dillane, J. D. Barber.

Course 1, IV Year; 3 hrs. laboratory per week, second term (1962–63 only).

The testing of bituminous materials used in highway construction and the analysis of bituminous paving mixtures. An introduction to practical soil mechanics is provided by a series of experiments investigating the physical and mechanical characteristics of soils related to highway and foundation work.

No laboratory report shall be written outside the assigned teaching hours.

Reference books: Specifications—Department of Highways, Ontario; A.S.T.M.; C.S.A.; A.A.S.H.O. Soil Testing for Engineers —Lambe.

52. Structural Engineering Problems. C. Hershfield, J. D. Barber, E. Karuks.

Course 3, IV Year; 3 hrs. per week, both terms.

Problems supplementing the work covered in lecture course 30 are assigned and worked out in the drafting room.

53. Structural Engineering Problems. C. Hershfield, A. C. Davidson, E. Karuks.

Courses 2 and 4, III Year; 3 hrs. per week, second term.

Problems supplementing the work covered in lecture course 29 are assigned and worked out in the drafting room.

54. Structural Engineering Problems. C. Hershfield, M. W. Huggins, E. Karuks.

Course 1A, IV Year; 3 hrs. per week, both terms (1962–63 only).

Problems supplementing the work covered in the lecture course 43 are assigned and worked out in the drafting room.

55. Mechanics of Materials II. J. Schwaighofer, K. Meipoom.

Course 1A, III Year; 2 hrs. lectures per week, both terms.

Cement and concrete technology, behaviour of metals, special topics on bending of beams, moving loads, influence lines, failure theories, introduction to experimental stress analysis.

Text: To be announced by the instructor.

56. Structural Theory I. C. F. Morrison.

Course 1A, III Year; 3 hrs. lectures per week, second term.

The stress analysis of simple span, continuous, and cantilever trusses. Influence lines and index stresses. Truss deflections by analytical and graphical methods. Analysis of statically indeterminate trusses, beams and frames by various methods.

Text book: Structural Theory—Sutherland and Bowman.

57. Structural Laboratory. C. F. Morrison, W. L. Sagar, M. W. Huggins, C. Hershfield, C. E. Helwig, J. Schwaighofer, E. Karuks, K. Meipoom.

Course 1A, III Year; 6 hrs. per week, both terms.

Problems and Laboratory to complement subjects 28, 55 and 56. Approximately one quarter of the total time will be devoted to the theory and design of concrete mixtures; aggregates; petrographic analysis.

APPLIED PHYSICS

70. Applied Physics. F. B. Friend, J. R. Bird.

Course 1, II Year; 2 hrs. lectures per week, first term.

Course 7, II Year; 2 hrs. lectures per week, second term.

Correlating the physical principles of light, sound, and vibration with problems in engineering, emphasizing the importance of the analytical approach.

71. Applied Physics Laboratory. F. B. Friend, J. R. Bird.

Course 1, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, second term.

Supplementing subject 70.

Two laboratory reports per term.

72. Optics. F. B. Friend.

Courses 8 and 9, II Year; 1 hr. lecture per week, both terms.

Light, geometrical and physical optics and optical instruments, photography and photo micrography.

Reference book: A Second Course in Light—A. E. E. McKenzie.

73. Optics Laboratory. F. B. Friend, J. R. Bird.

Courses 8 and 9, II Year; 3 hrs. laboratory per week, both terms.

A laboratory course supplementing subject 72.

Two laboratory reports per term.

75. Optics and Photogrammetry. K. B. Jackson, J. Vlcek.

Course 1B, III Year; 2 hrs. lectures per week, first term.

Optics of modern surveying instruments, including cartographic camera; photographic materials and processes as they effect the interpretability of photographs; camera calibration, geometry of a single picture, stereoscopy, simple methods of plotting from terrestrial and aerial photographs.

76. Optics and Photogrammetry Laboratory. K. B. Jackson, J. Vlcek.

Course 1B, III Year; 3 hrs. per week, first term.

Laboratory work supplementing the lecture course 75.

77. Photogrammetry. K. B. Jackson, J. Vlcek.

Course 1B, IV Year; 1 hr. lecture per week, both terms.

Photographic optics, photographic materials and processes,

photography applied to measurement. Terrestrial and aerial survey photography. Perspective, scale, tip and tilt, rectification. Planimetric mapping. Stereoscopy. Stereoscopic photographs and plotting instruments. Topographic mapping. Photo interpretation. The application of aerial photographs to mapping, to the survey of natural resources, and to planning and development.

78. Photogrammetry. K. B. Jackson, J. Vlcek, D. J. Gerrard.
Course 1B, IV Year; 3 hrs. laboratory per week, both terms.
Supplementing subject 77.
Two laboratory reports per term.

79. Photo Interpretation. D. J. Gerrard.
Course 1B, III Year; 2 hrs. lectures per week, second term.
The use of aerial photographs in geology, land use, forestry, etc.; methods of extracting, and for displaying the information available—all based on the use of a large collection of diversified photography.

80. Photo Interpretation Laboratory. D. J. Gerrard.
Course 1B, III Year; 3 hrs. per week, second term.
Laboratory work supplementing the lecture course 79.

82. Acoustics. V. L. Henderson.
Course 7, IV Year; 2 hrs. lectures per week, second term.
This subject deals with the properties of acoustical elements, particularly with their application in electrical sound systems.
Reference book: Elements of Acoustical Engineering—Olson.

83. Acoustics Laboratory. L. M. Steinberg.
Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.
Supplementing subject 82.
Three laboratory reports.

93. Illumination. Miss M. G. Currie, J. Chisvin.
Course 7, IV Year; 2 hrs. lecture per week, second term.
Illuminating Engineering dealing with the nature, measurement, and production of light and related radiations.
Theory of human vision; the design and application of lighting equipment for visual efficiency and comfort. Fundamentals of power supply.

94. Illumination Laboratory. Miss M. G. Currie, J. Chisvin.
Course 7, IV Year; 3 hrs. per week, second term.
Supplementing subject 93.
Three laboratory reports.

97. Acoustics. V. L. Henderson.
Course 5e, III Year; 2 hrs. lectures per week, first term.
Acoustics of electrical sound systems; including sound waves hearing, the mechanical-electrical-acoustical analogy, microphones, loud speakers, etc.
Reference book: Elements of Acoustical Engineering—Olson.

98. Acoustics Laboratory. L. M. Steinberg.

Course 5e, III Year; $1\frac{1}{2}$ hrs. laboratory per week, first term. Supplementing subject 97.

99. Vibration Engineering. V. L. Henderson.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

100. Vibration Laboratory. V. L. Henderson.

Course 5t, IV Year; 3 hrs. laboratory per week, both terms.

A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurements, and control of vibration in engineering problems.

Three laboratory reports per term.

ASSAYING, MINING AND ORE DRESSING

160. Assaying. W. A. M. Hewer.

Courses 2, 8, and 9, III Year; 1 hr. lecture per week, both terms.

Theory and practice of fire assaying. Emphasis is laid not only upon the principles of chemistry, metallurgy and sampling involved, but also upon the errors inherent in operators as well as in methods.

References: Manual of Fire Assaying—Fulton and Sharwood. Textbook of Fire Assaying—Bugbee. Fire Assaying—Shepherd and Dietrich. The Sampling and Assay of the Precious Metals—E. A. Smith.

161. Assaying Laboratory. W. A. M. Hewer.

Courses 2 and 9, III Year; 3 hrs. laboratory per week, both terms.

The determination of precious metals. Scorification, crucible and combination wet and dry methods of assaying ores both simple and complex; milling and metallurgical products including cyanide solutions, cyanide precipitates and gold bullion. Attention is also given to the sampling and assay of ores containing radio-active minerals.

162. Wet Analysis. W. A. M. Hewer.

Course 2, III Year; 3 hrs. laboratory per week, both terms.

Analysis of furnace products, base metal, and radioactive ores.

164. Assaying Laboratory. W. A. M. Hewer.

Course 8, III Year; 3 hrs. laboratory per week, first term.

The instruction in general is as described under subject 161, but omitting determinations on precious-metal bullions and radioactive minerals.

165. Mining. H. R. Rice, W. A. M. Hewer.

Courses 2 and 9, II Year; 1 hr. lecture and 2 hrs. laboratory per week, second term.

A combined lecture and laboratory subject in the principles of mining and its unit processes. Emphasis is placed on the statistical approach to sampling calculations.

168. Mining. H. R. Rice.

Courses 2 and 9, III Year; 3 hrs. lectures per week, first term.

Methods of mine development by mine adits, shafts, drifts and crosscuts; stoping methods, loading, and underground transportation.

169. Mining Laboratory. H. R. Rice, S. E. Wolfe.

Course 2, III Year; 3 hrs. laboratory per week, both terms.

Special mining problems are given relating to sampling, diamond drilling, stope measurements, the factors affecting the behaviour of broken materials. To develop the individual student's initiative, some special survey problems are worked in the laboratory.

170. Mine Operation and Administration. H. R. Rice.

Courses 2 and 9, IV Year; 2 hrs. lectures per week, both terms.

Lectures on advanced mining practice, including mining methods, ground control, mine mechanization, mine services and plant, aspects of administration and finance, and industrial relations.

172. Mining Laboratory. H. R. Rice.

Course 2, IV Year; 2 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A problem which progresses from essential geological data, to a complete design of the related mine, which integrates the principles of mine economics, selection of mining rates, ore-reserve calculations, and plant design.

173. Mining Laboratory. H. R. Rice.

Course 9, IV Year; 3 hrs. laboratory per week, second term.

Problems in mine layout involving shaft location and size; mine development; choice of stoping methods, mining rate, and mine equipment; time and cost schedules; ore reserve calculations.

175. Mine Ventilation and Allied Problems. G. R. Lord, F. G. Ewens.

Course 2, IV Year; 2 hrs. lectures per week, first term.

Ventilation problems in Canadian mines, including the use of ventilation equipment, selection of fans, testing equipment, ventilation studies, the silicosis problem, fire control, etc.

176. Mine Ventilation Laboratory. The Staffs in Mining and Mechanical Engineering.

Course 2, IV Year; 3 hrs. laboratory per week, first term.

Experiments in the laboratories and problems in the study room to give the student some practice in the use of ventilation test equipment, and the solution of ventilation problems. An aggregate of about ten off-campus study hours may be required in preparation of some reports.

180. Mineral Dressing. S. E. Wolfe.

Courses 2 and 8, III Year; 2 hrs. lectures per week, both terms.

The subject deals with the economics of, the theoretical principles and their practical application in, the treatment of ores and mineral aggregates. These involve the processes of crushing, grinding, sizing and classification; gravity, magnetic, and electrostatic separation; and an introduction to froth flotation. In addition, ancillary processes are studied. These include flocculation, sedimentation, filtration, drying of mineral products and the precipitation and collection of dust and fume.

181. Mineral Dressing Laboratory. S. E. Wolfe.

Course 8, III Year; 6 hrs. laboratory per week, second term.

The subject matter in general is as described under Subject 182, but with more emphasis on processes involving surface phenomena.

182. Mineral Dressing Laboratory. S. E. Wolfe.

Course 2, III Year; 6 hrs. laboratory per week, second term.

This work is coordinated with the lecture subject 180. Studies are made of crushing machinery, the principles of crushing and grading of rock products, screen analysis, and the sampling of broken material and mill products. Certain tests with gravity concentrating machines are made and an introduction to the technique of flotation test work is given.

183. Ore Dressing. S. E. Wolfe.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The subjects covered are extensions of those in 180, 181, and 182; cyanidation, flotation processes and techniques, the current practice at milling plants, and problems associated with milling.

184. Ore Dressing Laboratory. S. E. Wolfe.

Course 2, IV Year; 6 continuous hours per week, first term.

Advanced work coordinated with lecture subject 183 and pertaining to ore dressing appliances, the handling in bulk of finely divided solids, the selective flotation of sulphides, ore testing, and pilot plant mill runs.

186. Mineral Dressing. S. E. Wolfe.

Course 9, III Year; 2 hrs. lectures per week, first term.

This abridged subject deals with current practice and fundamental principles in the field of mineral beneficiation.

192\. Summer Essay. W. A. M. Hewer.

Course 2, III Year:

An essay, or report, written on a mining topic, preferably some phase of work with which the student is associated during summer employment. Subsequently, each student will deliver a talk to his class on the topic chosen. Thus, training is afforded in both technical writing and public speaking. Students are briefed in advance concerning requirements of this subject.

193\. Oral Expression. Mrs. Helen Tucker.

Courses 2 and 9, II Year; 2 hrs. seminar per week, second term.

A seminar series in oral expression. The objective is to improve the ability to speak as a means of communication. Clear expression of sound thinking is discussed and practised in speech assignments.

ASTRONOMY AND GEODESY

No laboratory reports shall be written outside the assigned teaching hours.

200\. Practical Astronomy. H. L. Macklin.

Course 1, II Year; 2 hrs. lectures per week, second term.

The derivation of formulae and their application to the solution of spherical triangles and practical problems. Practical determination of time, latitude and azimuth by methods adapted to the use of the surveyor's transit. The subject will be designed to enable the student to carry out these observations at the Summer Survey Camp.

Text books: Practical Astronomy—Nassau.

202\. Astronomy. H. L. Macklin.

Course 1B, IV Year; 1 hr. lecture per week, first term.

Precise determination of time, latitude, longitude and azimuth as applied to geodetic surveys.

203\. Astronomy. H. L. Macklin.

Course 1B, IV Year; 3 hrs. laboratory per week, first term.

Observations and problems to accompany subject 202.

204\. Geodesy. O. J. Marshall.

Course 1B, IV Year; 2 hrs. lectures per week, second term (1962–63 only).

Geometry of the spheroid, geographic co-ordinates, common map projections with related co-ordinate systems

205\. Geodesy. O. J. Marshall.

Course 1B, IV Year; 3 hrs. laboratory per week, second term. (1962–63 only).

Problems in geodetic computations.

206\. Geodetic Engineering. O. J. Marshall.

Course 1B, III Year; 2 hrs. lectures per week, second term.

Principles, equipment and methods of geodetic surveys involving triangulation, traverse and levelling of high precision; elementary geodesy and map projections.

207. Geodetic Engineering Laboratory.
Course 1B, III Year; 3 hrs. per week, second term.
Problems and computations supplementing the work covered in subject 206.

MUNICIPAL, SANITARY AND TRANSPORTATION ENGINEERING

208. Sanitary Engineering I. A. P. Bernhart.
Course 1, III Year; 2 hrs. lectures per week, first term.
Water supply and distribution for towns and cities. Waste water treatment and collection for residential and industrial developments. Protection of resources of water and air.

209. Highway Engineering. M. M. Davis.
Course 1, III Year; 2 hrs. lectures per week, first term.
Organization, administration, economics and planning of rural highways; highway materials and paving; principles of location, design, construction and maintenance.
Text Book: Highway Engineering—Hewes and Oglesby.
Reference Books: The Highway Improvement Act—Ontario Highway Standards and Specifications—Department of Highways of Ontario. Soil Mechanics for Road Engineers—D.S.I.R.—H.M. Printer, Policy on Geometric Design of Rural Highways—A.A.S.H.O.

214. Sanitary Engineering. A. P. Bernhart.
Course 1, IV Year; 2 hrs. lectures per week, both terms (1962–63 only).
Impact of towns and industries on cycle of water, protection of water resources. selfpurification.
Supply, purification and distribution of water. Collection and treatment of domestic and industrial waste water.
Control of air pollution.

215. Sanitary Engineering Laboratory. A. P. Bernhart.
Course 1, IV Year; 1½ hrs. per week, first term; 3 hrs. per week, second term (1962–63 only).
First term: Six inspection field trips to Water Purification and Sewage Treatment plants in the Toronto area. Six reports.
Second term: Design problems supplementing the work covered in Subject 214.

216. Municipal Planning, Administration and Transportation. H. L. Macklin, M. Hugo-Brunt, M. M. Davis.
Course 1, III Year; 3 hrs. lectures per week, second term.
Contemporary concepts in town and regional planning and their theoretical, practical and legal applications as applied in Canada.
Organization of municipal government, municipal finance, legislation governing municipal operation, role of the municipal engineer and private practitioner in public works, provisions of municipal services.

Urban and regional growth as affected by transportation, trends, demands, characteristics and capacities, co-ordination with land use and integration with other services.

217. Highway Engineering. M. M. Davis.

Course 1, IV Year; 1 hr. lecture per week, both terms (1962–63 only).

Organization, administration, economics and planning of rural highways; highway materials and paving; principles of location, design, construction and maintenance.

Text book: Highway Engineering—Hewes and Oglesby.

Reference books: The Highway Improvement Act—Ontario Highway Standards and Specifications—Department of Highways of Ontario. Soil Mechanics for Road Engineers—D.S.I.R.—H. M. Printer. Policy on Geometric Design of Rural Highways—A.A.S.H.O.

218. Construction Management and Business. M. G. Tallon, F. N. Beard.

Course 1, IV Year; 2 hrs. lectures per week, second term.

A study of heavy and building construction, including job planning and organization, construction methods and equipment, superintendence, job records, labour relations and safety procedures. Elements of business organization and management with an introduction to the principles of control through accounting records and financial statements.

219. Town and Regional Planning. M. Hugo-Brunt.

Course 1B, IV Year; 1 hr. lecture per week, first term.

Town Planning principles both past and present. The role of the planner, the plan, local legislation, the central area, the neighbourhood, subdivision, the suburb, open space and the region, housing, road layout, services, industry, commerce and special uses.

220. Town and Regional Planning. M. Hugo-Brunt.

Course 1B, IV Year; 3 hrs. practical work per week, first term.

Studio work including exercises in survey, research and analysis, subdivision layout, and urban analysis. These are related to subject 219.

CHEMISTRY AND CHEMICAL ENGINEERING

221. Chemistry. The Staff in Chemical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

Chemical theory, with industrial and engineering applications.

222. Chemical Laboratory. W. F. Graydon, J. Binkiewicz.

Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, I Year; 3 hrs. laboratory per week, both terms.

A laboratory course illustrating the fundamental laws of chemistry as dealt with in the lecture course, and providing an introduction to chemical analytical methods.

223. Chemistry. W. H. Burgess.
Course 5, I Year; 2 hrs. lectures per week, both terms.
Introductory physical chemistry: the gas laws, chemical equilibria, elementary solution chemistry, thermochemistry. Problems dealing with industrial and engineering applications.

224. Chemistry. W. F. Graydon, O. W. Berg.
Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.
Calculations based on systems in equilibrium; examples from pH solubility, complex formation and phase equilibrium.

225. Chemistry. A. D. Allen.
Course 7, II Year; 2 hrs. lectures per week, first term.
Inorganic Chemistry, with emphasis on the fundamental particles, atomic structure, the nature of the chemical bond and the general chemistry of the metallic elements.

226. Engineering Chemistry. W. H. Rapson, S. Sandler.
Courses 1, 3, and 4, II Year; 2 hrs. lectures per week, first term.
Corrosion and water-treatment; introduction to organic chemistry.

227. Analytical Chemistry Laboratory. W. F. Graydon, O. W. Berg.
Courses 2 and 9, II Year; 6 hrs. laboratory per week, first term.
Volumetric and gravimetric analysis.

228. Analytical Chemistry Laboratory. F. E. Beamish.
Course 8, II Year; 4 hrs. laboratory per week, both terms.
Quantitative and qualitatve analysis.

229. Analytical Chemistry Laboratory. R. E. Jervis, I. H. Spinner, C. P. Brockett.
Course 6, II Year.
This course commences on the Wednesday following the first Monday in September, and continues until the opening of the Fall Term. All the working time will be spent on systematic quantitative inorganic analysis.
Text book: Textbook of Inorganic Analysis—Kolthoff and Sandell.

230. Industrial Chemistry. W. G. MacElhinney.
Course 6, II Year; 2 hrs. lectures per week, first term: 1 hr. lecture per week, second term.
Manufacture of acids, alkalis, and inorganic chemicals; water-treatment, corrosion, explosives.

231. Inorganic Chemistry. R. E. Jervis.
Courses 6 and 8, II Year; 1 hr. lecture per week, first term: 2 hrs. lectures per week, second term.
The constitution of matter and classification of the elements: systematic inorganic chemistry.

232. Analytical Chemistry. I. H. Spinner, R. E. Jervis.
Course 6, II Year; 2 hrs. lectures per week, first term.
Equilibrium considerations in quantitative analysis.

233. Analytical Chemistry Laboratory. I. H. Spinner, C. P. Brockett.
Course 6, II Year; 9 hrs. laboratory per week, first term.
A continuation of Subject 229.

234. Organic Chemistry. J. G. Breckenridge.
Course 6, II Year; 1 hr. lecture per week, first term: 2 hrs. lectures per week, second term.
An introductory course in organic chemistry, with emphasis on reaction conditions and yields, and the industrial significance of certain compounds and reactions.
Text book: Systematic Organic Chemistry—Muldoon and Blake.

235. Chemical Engineering Science Laboratory. I. H. Spinner, C. P. Brockett.
Course 6, II Year; 12 hrs. laboratory per week, second term.
Experiments illustrating the kinetic and equilibrium principles of chemical engineering. Instruction is given in glass-blowing, and mass and heat balance calculations.
One laboratory report per week.

236. Physical Chemistry. S. S. Danyluk.
Course 6 and 8, II Year; 2 hrs. lectures per week, both terms.
An introductory course in chemical thermodynamics with emphasis on the thermodynamics of phase equilibria.

237. Inorganic Chemistry. A. D. Allen.
Course 5, II Year (elective); 2 hrs. lectures per week, both terms.
General inorganic chemistry, stereochemistry, and related physical measurements.

238. Physical Chemistry. R. W. Missen.
Course 5, II Year; 2 hrs. lectures per week, both terms.
A continuation of subject 223. Topics discussed include phase and reaction equilibrium, the latter following an introduction to chemical thermodynamics, reaction kinetics and electrochemistry.
Text Book: Physical Chemistry—Daniels and Alberty—2nd edition.

239. Chemical Theory A. W. H. Burgess, W. F. Graydon.
Course 6, III Year; 1 hr. lecture per week, both terms.
Chemical kinetics; principles of adsorption and colloid chemistry.

240. Chemical Theory B. W. H. Burgess, W. F. Graydon.
Courses 5c and 6, III Year; 2 hrs. lectures per week, both terms.
Chemical thermodynamics, introductory to subject 256.

241. Industrial Chemistry. W. G. MacElhinney, W. H. Rapson.

Course 6, III Year; 3 hrs. lectures per week, second term.

Chemical process industries, including petroleum, soap, sugar, pulp and paper, and fermentation industries. In preparation for this course, students will be expected to have read and to be thoroughly familiar with the following: Chemical Process Industries—Shreve: Chapters 29, 30, 31, 33, 34, 37.

242. Introduction to Mass and Heat Transfer. W. G. MacElhinney.

Course 6, III Year; 2 hrs. lectures per week, both terms; 3 hrs. laboratory per week, second term.

The fundamental theory and practice used in transfer operations in chemical engineering. Energy and mass transfer are considered in the study of the flow of fluids, fluidization of solids, heat transfer, and evaporation of solutions.

Text book: Unit Operations of Chemical Engineering—McCabe and Smith.

244. Organic Chemistry. J. G. Breckenridge.

Course 6, III Year; 2 hrs. lectures per week, both terms.

A continuation of subject 234, dealing mainly with aromatic compounds.

245. Organic Chemistry Laboratory. W. H. Rapson, Z. May.

Course 6, III Year; 9 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A laboratory course accompanying subject 244.

One laboratory report per week.

246. Electrochemistry. J. P. Valleau.

Course 6, IV Year; 2 hrs. lectures per week, first term.

Elementary electrochemistry.

247. Electrochemistry Laboratory. J. P. Valleau.

Course 8, III Year; Course 6, IV Year; 18 hrs., first term.

Quantitative measurements to accompany subject 246.

249. Chemical Laboratory. W. F. Graydon, Z. May.

Courses 5c and 6, III Year; 6 hrs. laboratory per week, both terms.

A laboratory course to accompany subject 240.

250. Organic Chemistry. J. G. Breckenridge, I. H. Spinner.

Course 5c, IV Year; 2 hrs. lectures per week, both terms.

A lecture course in organic chemistry, concluding with a section on the chemistry of high polymers.

251. Chemical Engineering Laboratory. R. L. Hummel, W. G. MacElhinney, R. W. Missen, O. Trass.

Course 6, IV Year; 10 hrs. laboratory per week, first term.

A laboratory course to accompany subjects 242, 253, and 254. Bench and pilot plant experiments are carried out to study a variety of unit operations such as fluidization, heat transfer,

evaporation, filtration, distillation, extraction, and absorption. Modern control instruments are discussed and operated.

One laboratory report per week.

252. Chemical Engineering Laboratory. Staff in Chemical Engineering.

Course 5c, IV Year; 6 hrs. laboratory per week, first term; 9 hrs. per week, second term.

Experiments illustrating the principles encountered in subjects 253 and 256.

253. Mass Transfer Operations. O. Trass.

Courses 5c and 6, IV Year; 2 hrs. lectures per week, both terms.

The theory and practice of mass transfer operations in chemical engineering are discussed. Many problems in distillation, extraction, absorption, and other operations illustrate the course.

Text book: Mass Transfer Operations—R. E. Treybal.

254. Chemical Plant Design. R. W. Missen.

Course 6, IV Year; 1 hr. lecture per week first term; 3 hrs. laboratory per week, second term.

The lectures deal with selected topics in plant design: process design, plant location, economics. In the second term, process design calculations are done for a particular plant, ending with an economic evaluation of the process. If possible, a visit is made to a nearby operating plant to illustrate the work done in the laboratory.

Text book: Chemical Engineering Plant Design—Vilbrandt and Dryden.

Reference book: Chemical Engineering Cost Estimation—Aries and Newton.

255. Applied Mathematics in Chemical Engineering. R. W. Missen.

Course 6, IV Year; 3 hrs. laboratory per week, first term.

A problems course dealing with selected topics in dimensional, graphical and numerical methods, statistics and differential equations.

Reference Books: Applied Statistics for Engineers—Volk; Applied Mathematics in Chemical Engineering—Mickley, Sherwood and Reed; Nomography and Empirical Equations—Davis.

256. Chemical Engineering Thermodynamics and Kinetics. W. H. Burgess, W. F. Graydon.

Courses 5c and 6, IV Year; 2 hrs. lectures per week, both terms.

The application of thermodynamics and kinetics to problems in the field of chemical engineering.

257. Organic Chemistry. R. R. McLaughlin, W. H. Rapson.

Course 6, IV Year; 1 hr. lecture per week, both terms.

The chemistry of natural and synthetic high-molecular-weight materials.

258. Organic Chemistry Laboratory. J. G. Breckenridge.

Course 5c, IV Year; 3 hrs. laboratory per week, first term.

A laboratory course to accompany subject 250.

262. Chemistry Laboratory. Staff in Chemical Engineering.

Course 5, II Year; 3 hrs. laboratory, alternate weeks, both terms.

Laboratory exercises to accompany subject 238.

263. Chemical Engineering Science Laboratory. Staff in Chemical Engineering.

Course 5, II Year (elective); 3 hrs. laboratory per week, second term.

An experimental introduction to transport phenomena.

DESCRIPTIVE GEOMETRY, ENGINEERING PROBLEMS AND DRAWING

DESCRIPTIVE GEOMETRY

269. Descriptive Geometry. C. A. Wrenshall, H. R. Frizzle.

All courses, I Year; 1 hr. lecture per week, both terms.

These lectures deal with the principles of orthographic, oblique and perspective projection and their use in solving problems of straight lines, planes, and curved surfaces.

Text book: Descriptive Geometry—Watts and Rule.

ENGINEERING PROBLEMS AND DRAWING

The courses in Engineering Problems and Drawing consist primarily in the solving of problems by the student at the drafting table under the personal guidance of an instructor. The problems deal with the fundamental engineering studies—mathematics, applied mechanics, descriptive geometry, the plotting of surveys that have been made by the student in the field, theory of machines.

275. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle, A. W. Walker.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 9 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (analytical geometry and calculus.) Plotting of original surveys for courses 1, 2 and 9.

Text book: Engineering Drawing—French and Vierck, latest Edition.

276. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle.

Course 5, I Year; 6 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry. Graphical and analytical solutions of problems in applied mechanics. Problems in mathematics (algebra and geometry, and calculus).

Text book: Engineering Drawing—French and Vierck, latest Edition.

284. Engineering Problems and Drawing. C. A. Wrenshall.

Course 1, II Year; 6 hrs. per week, both terms.

Problems in descriptive geometry—intersection of curved surfaces. Plotting of original surveys. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 9th Edition.

286. Engineering Problems and Drawing. B. M. M. Carpendale, C. L. Proctor.

Course 3, II Year; 6 hrs. per week, both terms.

Problems in descriptive geometry—intersection of curved surfaces. Problems in mechanics of materials, theory of machines. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 9th Edition.

287. Engineering Problems and Drawing. C. A. Wrenshall.

Courses 2, 6 and 9, II Year; 3 hrs. per week, alternate weeks, both terms.

Problems in mathematics.

288. Engineering Problems and Drawing. B. M. M. Carpendale, C. L. Proctor.

Course 4, II Year; 6 hrs. per week, both terms.

Problems in descriptive geometry—intersection of curved surfaces. Problems in mechanics of materials. Problems in mathematics.

Text book: Engineering Drawing—French-Vierck, 9th Edition.

289. Engineering Problems and Drawing. C. A. Wrenshall.

Course 8, II Year; 3 hrs. per week, both terms.

Problems in descriptive geometry and mathematics.

Text book: Engineering Drawing—French-Vierck, 9th Edition.

BUSINESS ADMINISTRATION, ECONOMICS, HISTORY AND LAW

306. Accounting. F. N. Beard.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Basic accounting principles and procedures, the preparation and interpretation of financial statements, cost accounting, and the use of accounting as a means of control.

310. Business. F. N. Beard.

Courses 2, 3, 7 and 9, III Year; 1 hr. lecture per week, second term.

Elements of business organization and management with an introduction to the principles of control through accounting records and financial statements.

311. Economics. D. F. Forster, J. H. Griggs, T. M. Russell, M. H. Watkins.

All courses, II Year; 2 hrs. lectures per week, both terms.

An Introduction to the study of Economics with special reference to the problems of the Canadian economy.

314. Engineering Law. W. O. Chris. Miller.

Courses 1, 3, 4, 6, and 7, IV Year; 1 hr. lecture per week, first term.

A subject designed to co-ordinate the practice of engineering and law. Consideration is given to the characteristics, advantages

and disadvantages of companies, partnerships and sole proprietorships, the promotion, organization and financing of companies, the duties of employees to employers, the duties and liabilities of engineers, statutes applicable to engineering works, professional engineering associations, construction contracts, workmen's compensation, trade unions and industrial disputes.

Text book: Engineering Law—Laidlaw and Young.

315. Industrial Management. B. M. M. Carpendale, P. B. Hughes.

Courses 3, 6, 7, IV Year; 1 hr. lecture per week, first term.

Introduction to principles of management and organization.

Subjects 314 and 315 are combined in one examination.

319. Public Speaking. The Staff in Chemical Engineering.

Course 6, III Year; 1 hr. per week, both terms.

320. Industrial Management. T. C. Graham.

Course 4, III Year; Course 4, IV year (1962–63 only); 2 hrs. lectures per week, both terms.

A study of the factors involved in the production and distribution of products or services. Consideration will be given to the general concepts of management, organization, leadership and industrial relations but major emphasis will be on work simplification, time and motion study, wage administration and controls of production, quality and costs.

322. Industrial Management Laboratory. T. C. Graham.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Cases and problems to accompany the lecture subject.

323. Introduction to Political Science. W. E. Grasham, J. T. McLeod.

All courses, I Year; 1 hr. lecture per week, both terms.

An introduction to the study of government with special reference to the problems of Canadian government.

324. Europe and the Modern World, 1500–1950. E. M. Beame.

All courses, III Year; 2 hrs. lectures per week, both terms.

An introduction to the main currents of European history between 1500 and 1950, and of European relations with the extra-European world. The purpose of the course is not the accumulation of factual information but the attainment of some understanding of historical processes, affecting the forms of political organization, economic activity, intellectual and social movements.

326. Philosophy of Science. Marcus Long, C. W. Webb.

Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, IV Year; 2 hrs. lectures per week, first term.

The relation between Science and Philosophy; an examination of the presuppositions of science and its basic concepts; alternative accounts of the nature of the universe with their implications for social and moral behaviour.

327. Industrial Psychology. W. Line.

Course 4, III Year; 2 hrs. lectures per week, second term.

A series of lectures and discussions on human relations, with the focus on some of the current problems in a developing industrial culture.

ELECTRICAL ENGINEERING

330. Electricity. Staff in Electrical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism, including Kirchhoff's Laws and network theorems as applied to direct-current circuits, induced voltages, self and mutual inductance and an introduction to electric field concepts. The MKS system of units is used.

331. Electricity. Staff in Electrical Engineering.

Course 5, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism that is similar to subject 330 but adapted to the needs of Course 5.

332. Electric Circuits I. A. J. Kravetz.

Course 7, II Year; 3 hrs. lectures per week both terms; 2 hrs. computation, alternate weeks, both terms.

The relation of lumped parameters to field concepts, their physical realization and their variation with frequency. The representation of simple systems by lumped parameter circuits.

The analysis of linear circuits in the steady state with either direct or alternating sources. Loop and nodal methods. The elements of the topography of circuits. Coupled circuits. Response of circuits to variable frequency.

The transient response of simple linear circuits to suddenly applied sources and its relation to the steady state.

Three-phase circuits, balanced and unbalanced. Other polyphase circuits.

General network theorems, rigorously derived, including the transformation theorems.

333. Electric and Magnetic Fields. G. R. Slemon.

Course 7, II Year; 2 hrs. lectures per week, both terms; 2 hrs. computation, alternate weeks, both terms.

Electric and magnetic fields, forces and energies associated with charged and current-carrying conductors embedded in dielectric and magnetic media. Particle dynamics in electric and magnetic fields. Time-varying fields in conductors and insulators. Development of Maxwell's equations and interpretation in static and dynamic situations.

334. Electrical Laboratory.

Courses 3 and 4, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, both terms.

Appropriate laboratory experiments to accompany subjects 332, 338, and 340.

Courses 3 and 4. Six laboratory reports.

Course 7. Ten laboratory reports.

335. Electrical Problems and Seminar.

Course 7, III Year; 4 hrs. per week, both terms.

Problems associated with courses 337, 339 and 341 are worked out under staff supervision. To provide practice in public speaking, one hour per week in the second term is devoted to short talks and discussions by the students on topics of their own choice.

336. Applied Mathematics. P. P. Biringer.

Course 7, III Year; 2 hrs. lectures per week, both terms; 2 hrs. computation per week, both terms.

Vector analysis; functions of a complex variable, with applications; numerical analysis.

337. Electronics. I. R. Dalton.

Course 7, III Year; 2 hrs. lectures per week, first term; 3 hrs. lectures per week second term.

The behaviour of charged particles in electromagnetic fields. Electrical conduction in solids and gases. Electron emission. Semiconductor and vacuum devices. Electronic circuits.

338. Electricity. H. A. Courtice.

Courses 3 and 4, II Year; 2 hrs. lectures per week, first term.

General principles and calculations of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power, and energy. The principles underlying commercial instruments are considered, together with the methods of calibration.

Reference books: Electrical Measurements—Laws. Basic Electrical Measurements—Stout.

339. Electric Machinery I. G. R. Slemon.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Processes for the electro-mechanical conversion of energy. The fields, forces and torques in singly and multiply-excited magnetic systems. Theory, characteristics and applications of direct-current machines. Introduction to the dynamic behaviour and control of machines. Theory and applications of transformers. Introduction to rotating magnetic fields.

Reference books: Electric Machinery—Fitzgerald and Kingsley. Principles of Direct-Current Machines—Langsdorf. Direct-Current Machinery—Kloeffler, Brenneman, and Kerchner.

340. Electrical Measurements. H. A. Courtice.

Course 7, II Year; 2 hrs. lectures per week, second term.

Measurement of electrical quantities such as charge, potential difference, current, magnetic flux, energy and power. Measurement of electrical properties such as dielectric constant, permeability and conductivity. Measurement of resistance inductance and capacitance. Transducers for electrical measurement of mechanical, thermal and other physical quantities. Measurement of alternating-current quantities in single phase and polyphase systems. Accuracy of measurement, curve fitting and treatment of measured data.

341. Electric Circuits II. V. G. Smith.

Course 7, III Year; 3 hrs. lectures per week, both terms.

Loop and nodal equations and methods of solution. Matrix notation. General theorems. Input and transfer admittances and impedances and dimensionless transfer functions. Symmetrical component analysis. Fourier series and integrals. Fourier and Laplace transforms, direct and inverse. Operational methods applied to transients in linear systems. Dependent sources. Two-port networks. Electrical filters.

342. Electric Machines. W. Janischewskyj.

Course 4, IV Year; 2 hrs. lectures per week, first term.

Operating characteristics and applications of transformers and rotating electric machines.

343. Electric Machines Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, first term.

Laboratory exercises to accompany subject 342.

Four laboratory reports.

344. Electrical Laboratory.

Course 7, III Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises to accompany subjects 339 and 341.

345. Electronics. P. E. Burke.

Courses 3 and 4, III Year; 2 hrs. lectures per week, first term.

Properties of vacuum tubes, gas tubes and semiconductors and their use as rectifiers and modulating devices. The use of circuit models containing ideal diodes and ideal controlled sources in analysing rectifiers and modulating devices.

346. Electronics Laboratory.

Courses 3 and 4, III Year; 3 hrs. laboratory alternate weeks, first term.

Laboratory exercise to accompany subject 345.

Four laboratory reports.

347. Electronics. J. L. Yen.

Course 5, a, c, g, n, t, III Year; 2 hrs. lectures per week, both terms.

Physical principles of electronic devices and their applications in linear and non-linear circuits. Simple instrumentation and control systems.

348. Electronics Laboratory.

Courses 5a, 5c, 5g, 5n, 5t, III Year; 1½ hrs. laboratory per week, second term. Laboratory experiments to accompany subject 347.

Five laboratory reports.

350. Circuit Analysis. V. G. Smith.

Course 5e, III Year; 2 hrs. lectures per week, both terms.

Advanced analytical methods are used to derive general network theorems and to discuss general network properties. Complex wave forms, filters and unbalanced polyphase networks are considered in detail.

352. Electromagnetic Engineering. G. Sinclair.

Course 7, IV Year; 2 hrs. lectures per week, both terms; 2 hrs. computation alternate weeks, both terms.

Maxwell's equations, wave equations, retarded potentials, reciprocity theorem, lumped and distributed circuits, transmission lines under transient and steady-state conditions, impedance charts, matching, waves in rectangular and circular waveguides, radiation from linear antennas, arrays, Tries transmission formula.

353. Electric Machinery II. G. F. Tracy.

Course 7, IV Year; 3 hrs. lectures per week, first term.

The theory and performance of generators, synchronous motors, single and polyphase induction motors.

Reference books: Principles of Alternating Current Machinery—Lawrence. Alternating Current Machines—Puchstein and Lloyd. Electrical Machinery—Fitzgerald and Kingsley.

354. Electric Circuits. R. J. Kavanagh.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Circuits as models for physical devices. Kirchhoff's laws. Transient response of circuits. Steady state response of circuits with sinusoidal excitation. Network theorems. Topology and loop and nodal analysis of general circuits. Complex frequency analysis of circuits. Response of circuits to variable-frequency excitation. Analysis of polyphase circuits. Magnetically coupled circuits.

Textbook: Circuit Analysis—Sabbagh.

355. Electric Machines Laboratory.

Course 7, IV Year; 3 hrs. laboratory per week, first term.

Laboratory exercises to accompany subject 353.

Four laboratory reports.

356. Electric Circuits Laboratory.

Course 5, II Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory exercises to accompany subject 354.
Ten laboratory reports.

357. Control Systems. J. M. Ham, R. J. Kavanagh.
Course 7, IV Year; 2 hrs. lectures per week, both terms.
A study of the analysis and synthesis of linear feedback control systems by means of differential equations and the Laplace transform. Topics covered include stability criteria, root-locus methods and compensation methods. An introductory study of non-linear systems is also made, including the use of describing-function and phase-plane methods of analysis.

358. Control Systems. J. M. Ham, R. J. Kavanagh.
Courses 5e, and 5n, IV Year; 2 hrs. lectures per week, both terms.
A course in linear and non-linear control systems that is similar to subject 357 but adapted to the needs of Courses 5e and 5n.

359. Control Systems Laboratory.
Courses 5e, 5n and 7, IV Year; 3 hrs. laboratory alternate weeks, both terms.
Laboratory experiments and design problem periods to accompany subjects 357 and 358.
Four laboratory reports.

360. Electronic Circuits. J. E. Reid.
Courses 5e, 5m, 5p and 7, IV Year; 3 hrs. lectures per week, first term.
The basic principles of amplification, detection, modulation, demodulation, and radio-frequency power generation.
Reference book: Applied Electronics—Gray.

361. Communications Laboratory.
Courses 5e, 5m, 5p and 7, IV Year; 3 hrs. laboratory per week, first term.
Experiments and problems to accompany subject 360.
Six laboratory reports.

362. Communication Systems. J. E. Reid.
Courses 5e and 7, IV Year; 3 hrs. lectures per week, second term.
A continuation of subject 360 covering theory and design of Class B and C amplifiers, power oscillators, crystal oscillators. Noise in communication circuits. Frequency conversion. Impedance transformation.
Reference book: Applied Electronics—Gray.

363. Communications Laboratory.
Courses 5e and 7, IV Year; 3 hrs. laboratory per week, second term.
Experiments and problems to accompany subjects 362 and 371.
Seven laboratory reports.

364. Operational Methods. V. G. Smith.

Courses 5e, 5m, 5n, 5p and 5t, IV Year; 2 hrs. lectures per week, both terms.

Classical and Heaviside's operational methods are developed. Fourier's methods leading to the Laplace transforms are discussed and the close relationship between Laplace and Heaviside emphasized. Applications are chiefly to electric circuit analysis.

Reference books: Transformation Calculus and Electric Transients—Goldman. Electromagnetic Theory—Heaviside. Transients in Linear Systems—Gardner and Barnes. Simple Calculation of Electrical Transients—Carter.

365. Applied Electromagnetic Theory. G. Sinclair.

Courses 5e, 5g, 5m, 5n and 5p, IV Year; 2 hrs. lectures per week, both terms.

Electrostatics is reviewed and developed further to compute the capacities of engineering structures. Electromagnetism is reviewed and Maxwell's equations obtained. These are then applied in a study of plane waves, wave guides and antenna radiation.

366. Electronics. J. L. Yen.

Course 5 e, m, p, III Year; 2 hrs. lectures per week, both terms.

Introduction to electrodynamics and electrical conduction in solids and gases. Physical principles of electron devices. Linear and non-linear circuits using electron devices.

367. Alternating-Current Circuits. I. R. Dalton, P. E. Burke.

Courses 1 and 2, II Year; 2 hrs. lectures per week, first term.

Courses 3 and 4, II Year; 2 hrs. lectures per week, second term.

Fundamentals of alternating current, voltage and power. The analysis of series, parallel and three-phase circuits containing resistance, inductance and capacitance.

368. Alternating-Current Circuit Laboratory.

Courses 1 and 2, II Year; 3 hrs. laboratory alternate weeks, first term.

Courses 3 and 4, II Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 367.

Three laboratory reports.

369. Electric Machinery III. G. F. Tracy.

Course 7, IV Year; 2 hrs. lectures per week, second term.

A continuation of subject 353. Special types of alternating current motors, synchronous converters, single-phase induction motors, frequency changes, selsyn devices.

370. Alternating Current Machinery Laboratory.

Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subjects 369 and 373.
Three laboratory reports.

371. High-Frequency Electronics. G. Sinclair.
Courses 5e and 7, IV Year; 2 hrs. lectures per week, second term.
Equivalent circuits for vacuum tubes at high frequencies, induced currents, klystrons, magnetrons, travelling-wave tubes, coupled mode theory, parametric amplifiers.

372. Electric Machines. P. P. Biringer.
Course 5e, III Year; 2 hrs. lectures per week, both terms.
Theory and applications of transformers, direct-current and alternating-current machines. Non-linear power modulators.

373. Electric Power Systems. G. R. Slemon.
Course 7, IV Year; 2 hrs. lectures and 2 hrs. computation per week, second term.
The theory associated with the economic generation, transmission and distribution of electrical energy in bulk and the control of power systems under normal and fault conditions.

374. Electric Machines Laboratory.
Course 5e, III Year; 3 hrs. laboratory alternate weeks, both terms.
Laboratory experiments to accompany subject 372.

375. Electrical Engineering. A. Straughen.
Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.
Basic d.c. measurements. Principles of single-phase and three-phase alternating currents. Elementary transients. Basic a.c. measurements. Principles of operation of d.c. and a.c. machines. Introduction to electronics.
Text book: Basic Electrical Engineering—Fitzgerald and Higginbotham.

376 Electrical Laboratory.
Courses 6 and 8, II Year; 3 hrs. laboratory per week, both terms.
Laboratory experiments to accompany subject 375.
Ten laboratory reports.

377. Electric Machines. A. J. Kravetz.
Course 3, III Year; 2 hrs. lectures per week, both terms.
Operating characteristics, control, and applications of direct-current and alternating-current machines.

378. Electric Machines Laboratory.
Course 3, III Year; 3 hrs. laboratory alternate weeks, first term; 3 hrs. laboratory per week, second term.
Laboratory exercises to accompany subject 377.
Seven laboratory reports.

379. Electronics Laboratory.
Courses 5e, 5m, 5p and 7, III Year; 3 hrs. laboratory per week, second term.
Laboratory experiments to accompany subjects 337 and 366.
Five laboratory reports.

GEOLOGICAL SCIENCES

380. Physical Geology. P. A. Peach.
Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.
Course 5g, III Year; see subject 413.
An introduction to the study of geology and mineralogy.
Reference books: Principles of Geology—Gilluly, Waters and Woodford *or* Physical Geology—Leet and Judson.

381. Physical Geology Laboratory.
Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. laboratory and 1 hr. tutorial per week, first term.
A laboratory course to accompany subject 380.

382. Engineering Geology. W. H. Gross.
Course 1, II Year; Course 1, III Year (1962–63 only); 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
An introduction course in geology with special reference to engineering problems.

383. Engineering Geology Laboratory.
Course 1, II Year; 1 hr. per week, first term; 2 hrs. per week, second term.
Course 1, III Year (1962–63 only); 2 hrs. per week, first term; 1 hr. per week, second term.
Specimens, maps and sections to accompany subject 382.

384. Glacial Geology and Ground Water. R. E. Deane.
Course 2, IV Year; 1 hr. lecture per week, both terms.
Pleistocene Geology. The formation and distribution of the drift deposits of North America, with emphasis on their economic importance.

385. Elementary Geochemistry. F. G. Smith.
Course 9, III Year; 2 hrs. lecture per week, both terms.
Covering the periodic table, distribution of the elements, states of matter, phase diagrams, natural hydrothermal solutions, weathering, and geochemical cycles.

386. Mineralogy and Lithology. D. H. Gorman, P. A. Peach.
Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. lecture per week, both terms.
A study of crystallography, descriptive and determinative mineralogy, and the common rocks.
Reference book: An Introduction to the Study of Minerals—Rogers.

387. Mineralogy and Lithology Laboratory. D. H. Gorman, P. A. Peach.
Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. per week, both terms.
Practice in identifying minerals and rocks.

388. Descriptive Mineralogy. D. H. Gorman.
Course 9, III Year; 2 hrs. laboratory per week, both terms.
Continuation of the mineralogy of subject 386

389. Ore Microscopy. D. H. Gorman.
Course 9, III Year; 3 hrs. laboratory per week, second term.
Identification of minerals in polished sections.

390. Crystallography. E. W. Nuffield.
Courses 5c, 5m, 5s and 8, III Year; 1 hr. lecture per week, both terms.
The modern concept of crystals; symmetry elements; derivation of space lattices, classes, forms, indices.

391. Petrology. P. A. Peach.
Course 9, III Year; 3 hrs. lecture per week, first term; 2 hrs. lecture per week, second term.
Microscopic character of the rock-forming minerals in thin sections, and description and classification of rocks.

392. Petrography Laboratory. P. A. Peach.
Course 9, III Year; 2 hrs. per week, both terms.
Microscopic petrography, to accompany subject 391.
Text book: Optical Mineralogy—Rogers and Kerr.

393. Historical and Stratigraphical Geology. F. W. Beales.
Courses 2 and 9, II Year; 2 hrs. lectures and 1 hr. tutorial per week, second term.
Study of the principles of stratigraphy and historical geology since Precambrian times.

394. Historical and Stratigraphical Geology Laboratory. F. W. Beales.
Course 9, II Year; 2 hrs. per week, second term.
Laboratory work to illustrate subject 393.

395. Palaeontology. M. A. Fritz.
Course 9, III Year; 2 hrs. lecture per week, both terms.

396. Palaeontology Laboratory. M. A. Fritz.
Course 9, III Year; 2 hrs. per week, both terms.

397. Structural Geology. J. B. Currie.
Courses 2, 5g and 9, III Year; 1 hr. lecture per week, both terms.
Structures caused by the deformation of the earth's crust.
Text book: Structural Geology—Billings.

398. Structural Geology Laboratory. J. B. Currie.
Courses 2, 5g and 9, III Year; 3 hrs. per week, both terms.
Work with geological maps of folded and faulted areas, structural sections, and the solution of problems relating to folding and faulting.
Laboratory course to accompany subject 397.

399. Mineral Deposits. W. H. Gross.
Courses 2, 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
Theories of origin of mineral deposits and description of world's important mineral deposits.

400. Mineral Deposits Laboratory. W. H. Gross.
Course 9, IV Year; 3 hrs. per week, second term.

401. Geology of Canada. F. W. Beales.
Course 9, IV Year; 1 hr. lecture per week, both terms.
A reading survey of the physiography, historical geology, major structural features, and mineral deposits of the country.

402. Pleistocene Geology. R. E. Deane.
Course 9, IV Year; 2 hrs. lecture per week, both terms.
Study of the Pleistocene Deposits of North America and Europe.

403. Precambrian Geology. W. W. Moorhouse.
Courses 2, 5g, and 9, IV Year; 2 hrs. lecture per week, first term.
Precambrian formations of Canada—their rocks, distribution, relationships and economic features.

404. Precambrian Geology Laboratory. W. W. Moorhouse.
Courses 2 and 5g, IV Year; 1 hr. laboratory per week, first term.
Course 9, IV Year; 3 hrs. laboratory per week, both terms.
To accompany subject 403.

405. Mining Geology. G. B. Langford.
Courses 2 and 9, IV Year; 2 hrs. lecture per week, second term.
A course dealing with the application of geology to mining.
Reference book: Mining Geology—McKinstry.

406. Mining Geology Laboratory. G. B. Langford.
Course 9, IV Year; 3 hrs. per week, first term.

407. Petroleum Geology. J. B. Currie.
Courses 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
The origin, nature, and occurrence of petroleum and natural gas deposits and the extraction of these substances from the earth.

408. Petroleum Geology Laboratory. J. B. Currie.
Courses 5g and 9, IV Year; 3 hrs. per week, second term.
Accompanying subject 407.

409. Stratigraphy and Sedimentation. F. W. Beales.
Course 9, III Year; 2 hrs. lectures per week, first term.
Description, classification and interpretation of sedimentary rocks and rock units.

410. Stratigraphic and Sedimentary Field Work. F. W. Beales.
Course 9, III Year; 2 hrs. per week, second term.
Field work along the Niagara Escarpment.

411. Petrological, Mineralogical and Structural Field Work.
Course 2, III Year: 7 days.
Course 9, III Year: 14 days.
A field camp in the Tweed area of Ontario. Laboratory work in the field complementing subjects 391 and 398.

412. Geological Field Trips (Glacial Geology).
Courses 2 and 9, IV Year. Two trips.
During the fall trips will be made to points of interest near Toronto.

413. Physical Geology. P. A. Peach.
Course 5g, III Year.
A reading course during the summer preceding the III Year. A special examination will be held early in October. Students who do not pass this examination will be required to write the examination in Subject 380 in January.

414. Geological Field Trips (Economic and Mining).
Course 9, IV Year. Two trips, each ½ day.
Trip to gypsum mine and cement plant.

415. X-Ray Crystallography. E. W. Nuffield.
Course 5m, IV Year; 2 hrs. lectures per week, first term.
X-ray diffraction methods and their application in the study of crystalline materials.

HEAT ENGINEERING

No laboratory reports to be written outside of assigned teaching hours.

420. Elementary Heat Engines. P. B. Hughes.
Course 3, II Year; 2 hrs. lecture per week, second term.
The history and development of heat engines, the principles upon which they operate, and the characteristic features of the different kinds of engines used in practice. The First and the Second laws of thermodynamics.
Text book: Thermodynamics—Obert.
Reference books: Thermodynamics of Heat Power—Faires. Steam, Air and Gas Power—Severns, Degler and Miles.

421. Engineering Thermodynamics. F. C. Hooper.
Course 3, III Year; 2 hrs. lectures per week, both terms.
A continuation of subject 420.
The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer. Regeneration.
Text book: Thermodynamics—Obert.

422. Heat Engineering. F. C. Hooper, W. A. Wallace.
Course 3, III Year; 2 hrs. lecture per week, first term; 1 hr. lecture per week, second term.

Steam Generators. Combustion calculations; analysis of fuels and products of combustion; boiler tests and heat balance; principles of design of boilers, furnaces, stokers, pulverised fuel, oil and gas firing equipment, economizers, air heaters, superheaters, feedwater heaters.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, McNaughton, Zerban and Nye.

Internal Combustion. Types and operation; performance and testing; basic characteristics and principles of design; carburation; fuel injection; governing.

Text book: The Internal Combustion Engine—Taylor and Taylor.

Reference book: Internal Combustion Engines—Fraas.

Heat Transfer and Air Conditioning. Conduction, convection, radiation, and combined mechanisms of heat transfer. Air and water vapour mixtures, requirements for comfort and industrial processes; the use of psychrometric charts; heating, cooling, humidifying and dehumidifying processes; calculation of air conditioning loads; air conditioning systems and equipment.

Reference book: A.S.H.R.A.E. Guide.

423. Heat Engineering Laboratories. F. C. Hooper, P. B. Hughes, W. A. Wallace, W. J. Moroz, C. H. Miller, J. L. Loth.

Courses 3 and 5t, III Year; 1 three-hour laboratory period per week, both terms.

Course 7, III Year; 1 three-hour laboratory period per week, first term.

Courses 4 and 6, III Year; 1 three-hour laboratory period per week, second term.

The laboratory work is designed to assist in clearer understanding of theory and practical applications, and consists of selected experiments in four laboratories: Heat Engine laboratory, Fuel Testing laboratory, Heat Transfer laboratory, Refrigeration and Air Conditioning laboratory.

The work on Heat Engines deals with the timing of engines, measuring indicated and brake horse-power, the use of power plant instruments, testing of air compressors, steam engines, steam turbines, internal combustion engines and gas turbines under various conditions, steam calorimetry and the solution of practical problems on steam plants, internal combustion engines, and gas turbines.

The Fuel Testing includes analysis of fuels and products of combustion, knock rating of gasolines, fuel calorimetry, etc.

The work on Heat Transfer deals with temperature measurement, tests on insulation and heat exchangers of various kinds.

The work on air conditioning deals with the use of instruments and charts, air conditioning standards, the solution of practical problem, and testing of air conditioning equipment.

424. Heat Power Engineering. P. B. Hughes.

Course 3, IV Year; 2 hrs. lecture per week, both terms.

A continuation of subjects 421 and 422. Evaporators and miscellaneous heat exchangers. Condensers and auxiliary power plant equipment. Theory and design of turbines. Power plant cycles including reciprocating engines and turbines. Cycles for high pressures and temperatures. Superheating, reheating, regenerative binary-fluid and supercritical pressure cycles. Steam generators employing forced circulation, indirect evaporation and pressure combustion. Power plant heat balance and efficiencies. Design of power plant equipment. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Heat and Thermodynamics—Zemansky. Engineering Thermodynamics—Obert, Lee and Sears, Soo, Van Wylen, Hawkins and Jones. Steam Power Plants—Gaffert, Zerban and Nye. Steam Turbines—Church, Salisbury, Lee, Shepheard.

425. Internal Combustion. W. A. Wallace.

Course 3, IV Year; 1 hr. lecture per week, both terms.

A survey of present and potential fuel resources. Characteristics of fuels and their combustion requirements. Operating cycles and losses involved, for both the reciprocating engine and the turbine plant. The theory of superchargers and rotary compressors. Factors governing the selection of equipment for an I.C. plant.

Reference book: The Internal Combustion Engine—Taylor and Taylor.

426. Heat Engineering Labtoratories. F. C. Hooper, P. B. Hughes, W. A. Wallace, A. B. Allan, C. H. Miller, W. J. Moroz, J. L. Loth.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 5 hrs. laboratory per week, second term.

Course 5t, IV Year; 3 hrs. laboratory work per week, both terms.

A continuation and extension of the work covered in the III Year laboratory subjects consisting of selected experiments in four laboratories: Heat Engine laboratory, Fuel Testing laboratory, Heat Transfer laboratory, Refrigeration and Air Conditioning laboratory.

In the Heat Engine laboratory complete tests are made of various engines such as simple, compound and uniflow steam engines, impulse and reaction type steam turbines, gas, oil and gasoline engines. In each case an analysis is made of the thermal cycle involved, a complete set of experiments is performed and the results plotted to show clearly to the student the effect of various alterations in adjustment on the results obtained. A complete boiler test is performed and all calculations are made for a heat balance. An analysis is made of cycles used in gas turbines and jets and complete tests are performed on a gas turbine plant and on a free-piston engine. Problems involving variable specific heat are studied.

In the Fuel Testing laboratory the octane rating of gasoline samples is determined by A.S.T.M. methods and fuel injection spray characteristics are studied with special test equipment.

In the Heat Transfer laboratory tests are made on heat exchangers.

In the Air Conditioning and Refrigeration laboratory tests are performed on complete air conditioning systems, and complete refrigerating plants.

427. Engineering Thermodynamics. J. L. Loth.

Course 2, III Year; 1 hr. lecture per week, both terms.

Thermodynamics of gases and vapours as applied to engines, nozzles, turbines, compressors, heat exchangers, refrigeration plants, and air conditioning systems. Analysis of vapour and gas power cycles.

Text book: Basic Thermodynamics—Brown.

Reference books: Engineering Thermodynamics — Young, Ebaugh. Thermodynamics of Heat Power—Faires.

428. Heat Engine Laboratory. F. C. Hooper, P. B. Hughes, W. A. Wallace, W. J. Moroz, C. H. Miller, J. L. Loth.

Course 2, III Year; 3 hrs. per week, second term.

Experiments with steam and internal combustion engines, compressed air, etc.

429. Refrigeration and Air Conditioning. F. C. Hooper.

Course 5t, IV Year; 2 hrs. lecture per week, first term.

The thermodynamic cycles and processes of special interest in refrigeration are outlined and the properties of ideal and actual refrigerants examined. Basic psychrometric processes are reviewed and related to air conditioning system performance.

Text book: Theory of Mechanical Refrigeration—Sparks and Di Ilio.

Reference book: A.S.H.R.A.E. Guide.

430. Heat Power Engineering. P. B. Hughes.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Application of Thermodynamics to the design of power plant equipment. Analysis of high pressure and high temperature vapour cycles. Superheating, reheating, regenerative, binary-fluid and supercritical pressure cycles. Steam generators employing forced circulation, indirect evaporation and pressure combustion. Steam turbines, power plant heat balance and efficiencies. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, Zerban and Nye. Steam Turbines—Church, Salisbury, Lee. Engineering Thermodynamics—Obert, Keenan, Hawkins and Jones.

431. Engineering Thermodynamics. P. B. Hughes.

Course 6, III Year; 2 hrs. lecture per week, first term.

The theory and practice of heat engines, including a study of fundamental principles involved, an appraisal of theoretical developments, and a survey of the corresponding practical applications.

Text book: Thermodynamics of Heat Power—Faires.

432. Heat Transfer. C. H. Miller.

Course 8, IV Year; 2 hrs. lecture per week, second term.

Basic principles, definitions, units and dimensional analysis. Conduction in the steady and the unsteady states. The heat source within a conducting body. Free and forced convection. Condensing and boiling. Radiation. Combined effects of conduction, convection and radiation. Instrumentation and experimental methods.

Text book: Elements of Heat Transfer and Insulation—M. Jakob and G. A. Hawkins.

433. Heat Transfer. F. C. Hooper.

Courses 5t and 5n, IV Year; 2 hrs. lecture per week, second term.

Steady state and transient conduction, surface and gas radiation, convection, boiling, condensation and combined mechanisms are considered. Special attention is given to analogue and computational procedures and to consideration of the manner in which novel or complex problems may be approached.

Text book: Heat Transmission—McAdams.

434. Engineering Thermodynamics. A. B. Allan.

Course 1, II Year; 2 hrs. lectures per week, second term.

Course 1, III Year; 2 hrs. lectures per week, second term (1962–63 only).

The fundamentals of engineering thermodynamics. The First and Second Laws. Properties of substances. Heat transfer. Heat exchangers. Compressors, fans, pumps, reciprocating engines and turbines. Vapour and gas power cycles. Refrigeration. Air-conditioning.

Text book: Basic Thermodynamics—Brown.

Reference book: Engineering Thermodynamics—Ebaugh.

435. Engineering Thermodynamics. R. W. P. Anderson.

Course 4, III Year; 2 hrs. lectures per week, second term.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles used in practice for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer.

Text book: Thermodynamics—Faires.

436. Internal Combustion. A. B. Allan.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Analysis of the processes and fundamental problems of internal combustion machines. Consideration of the deviations from ideal behaviour. Fuels, combustion, ignition, detonation and other combustion problems. Experimental techniques in the study of internal combustion machines. A consideration of engine design.

Text book: Internal Combustion Engines—Obert.

Reference book: Internal Combustion Engines—Lichty.

437. Thermodynamics. R. W. P. Anderson.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

A development of the fundamental laws of thermodynamics and of their application in engineering. Internal combustion and steam power, refrigeration, heat transfer, psychrometry and air conditioning.

Text book: Elements of Thermodynamics and Heat Transfer—Obert.

438. Heat Engineering. W. A. Wallace, F. C. Hooper, S. Sandler.

Course 5t, III Year; 2 hrs. lectures per week, both terms.

Steam Generation: Analysis of thermodynamic systems used in industrial plants and power plants; heat transfer and insulation; fuels and combustion; power plant testing; principles involved in the design of boilers, furnaces, stokers, pulverised coal, oil and gas firing equipment, economisers, air heaters, superheaters, feedwater heaters and feedwater treatment plants.

Text book. Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, McNaughton, Zerban and Nye.

Internal Combustion: Types of engines and turbines and their operation characteristics; performance and testing; principles involved in design; fuel systems; governing.

Text book: Internal Combustion Engines—Obert.

HYDRAULICS AND FLUID MECHANICS

No laboratory reports to be written outside of assigned teaching hours.

440. Fluid Mechanics. G. R. Lord, L. E. Jones, C. L. Proctor, H. J. Leutheusser, J. F. Keffer.

Courses 1, 3, and 4, III Year; 2 hrs. lectures per week, both terms.

Attention is given to the development and discussion of the fundamental principles of fluid flow. These principles are illustrated by suitable practical problems connected with fluid measurements, flow of fluids in pipes and open channels, with a brief discussion of the resistance of submerged bodies, dimensional analysis and similarity studies.

441. Fluid Mechanics Laboratory. G. R. Lord, L. E. Jones, C. L. Proctor, H. J. Leutheusser, J. F. Keffer.

Courses 1 and 3, III Year; one 3-hr. laboratory period per week, second term.

Course 4, III Year; one 3-hr. laboratory period per week, first term.

This laboratory course is planned to illustrate the principles considered in the lecture courses in fluid mechanics. Experimental work in the laboratory utilizes a wide variety of apparatus and equipment concerned with fluid flow, while problems undertaken in the study room provide a link with general engineering practice.

443. Hydraulics. G. R. Lord.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

The general field of applied hydraulics and fluid mechanics is studied under the topics: hydrology; hydro-electric power plants and auxiliaries; conservation and flood control; canals, pipelines, etc., under both steady and unsteady conditions; hydraulic machinery, fans, compressors, turbines, pumps, etc., design, selection and operation; power and control circuits; flow of compressible fluids; similarity and model investigations; industrial applications.

444. Hydraulic Laboratory. G. R. Lord, L. E. Jones, J. F. Keffer.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 5 hrs. laboratory per week, second term.

Experimental work is carried out in the laboratory on various types of pumps, turbines, fans, centrifugal compressors and on hydraulic models. In addition computation problems involving open channel flow, water power studies, pumps and turbine studies, water hammer phenomena, fans and ductwork, and other advanced flow problems are considered. General problems involving compressibility of gases are considered.

445. Hydraulic Engineering. W. D. Baines.

Course 1, IV Year; 2 hrs. lectures per week, both terms.

Applications of fluid mechanics to civil engineering problems, particularly discussion of flow in pipes and open channels, surge tanks, water hammer, pumps and turbines. Theory and applications of hydrology including precipitation, run-off, snowmelt, ground water, evaporation and hydrograph analysis.

446. Hydraulic Engineering Laboratory. G. R. Lord, L. E. Jones, W. D. Baines, H. J. Leutheusser.

Course 1, IV Year; one 1½-hr. laboratory period per week, first term; one 3-hr. laboratory period per week, second term.

Experimental studies of hydraulic models, turbines and pumps are carried out. Problems assigned in the study rooms deal with channel flow and other hydraulic features connected with water power installations, flood control, water supply and drainage systems.

447. Fluid Mechanics. L. E. Jones.

Course 7, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Physical characteristics of fluids; fundamental concepts of fluid mechanics, experimental techniques and principles of systematic analysis; boundary layers, wakes and turbulence; pipe and channel systems; dynamics of compressibility; oscillations and waves; forces and moments on immersed bodies; fluid machinery; introduction to systems encountered in engineering practice.

448. Fluid Mechanics Laboratory. L. E. Jones, C. L. Proctor.

Course 7, IV Year; 3 hrs. laboratory per week, second term.

Laboratory experiments and design problems to illustrate subject 447.

449. Treatment of Technical Data. L. E. Jones.

Course 3, II Year; 2 hrs. lecture per week, second term.

Presentation of data; approximate nature of technical data; role played by mathematics; general numerical methods; methods of organizing data for computation; methods of analyzing technical data; elements of curve-fitting and statistical treatment.

452. Fluid Mechanics. L. E. Jones, H. J. Leutheusser.

Courses 6 and 8, III Year; Course 8, IV Year (1962–63 only); 2 hrs. lectures per week, first term.

The fundamentals of fluid flow as generally encountered in industry. Fluid properties, fluid statics, energy relations, dimensional analysis and dynamic similarity, flow in pipes and channels, resistance of submerged bodies, effects of viscosity and compressibility, lubrication, pumps and other hydraulic machines.

453. Fluid Mechanics Laboratory. G. R. Lord, L. E. Jones, H. J. Leutheusser.

Course 6, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit of correlating flow fundamentals with industrial applications.

454. Fluid Flow and Pumping Systems. L. E. Jones, H. J. Leutheusser, J. F. Keffer.

Course 2, III Year; 3 hrs. lectures per week, first term.

A discussion of the fundamental principles of fluid flow, with special attention to problems encountered in mining.

455. Fluid Flow and Pumping Systems Laboratory. G. R. Lord, L. E. Jones, H. J. Leutheusser, J. F. Keffer.

Course 2, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit correlation of flow fundamentals with mining applications.

MACHINERY

No laboratory reports written outside of assigned teaching hours.

461. Mechanical Engineering. R. T. Waines.

Course 3, II Year; 1 hr. lecture per week, first term.

Prior to registering in Second Year, the student is required to study the prescribed text, covering the topics of design materials and manufacturing methods and processes. The lecture work will involve discussion of the text matter, as well as new materials and processes. The final examination (in January) will cover both the prescribed study and the lecture work.

Text book: Manufacturing Processes and Materials for Engineers—Doyle, Morris, Leach and Schrader.

463. Mechanical Engineering. R. T. Waines.

Course 4, II Year; 2 hrs. lectures per week, both terms.

Materials of design and production methods. In addition, standards, tolerances, limits, fits and mechanical drafting room practice will be explained.

Text books: Manufacturing Processes and Materials for Engineers—Doyle, Morris, Leach and Schrader. Drawings and Drafting Room Practice. A.S.A.

464. Mechanical Engineering Laboratory. I. W. Smith, R. T. Waines.

Course 4, II Year; 3 hrs. laboratory per week, second term.

An introduction to the principles and techniques of fine measurement and instrumentation. Problems dealing with tolerances, force analysis, etc., will also be given.

465. Dynamics of Machines. D. L. Allen.

Course 3, II Year; 3 hrs. lectures per week, both terms.

Basic equations for accelerated motion of mass are developed and applied to the analysis of machine elements. Velocity, acceleration, force distribution, speed fluctuation and balancing of machines are considered. Standard linkages, cams, gears, flywheels, governors and gyroscopes are given specific attention.

Text books: Engineering Dynamics—Hooper and Smith. Kinematics and Dynamics of Machinery—Maxwell.

466. Dynamics of Machines Laboratory. I. W. Smith, R. T. Waines, D. L. Allen.

Course 3, II Year; 1½ hrs. laboratory per week, both terms.

The work in the laboratory will illustrate the principles covered in lecture subject 465.

467. Machine Design. I. W. Smith.

Course 3, III Year; 2 hrs. lectures per week, both terms.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Faires.

468. Machine Design Laboratories. I. W. Smith, R. T. Waines, G. E. Godfrey, J. VandeVegte.

Course 3, III Year; 4½ hrs. laboratory per week, first term;

6 hrs. laboratory per week, second term.

Course 7, III Year; 3 hrs. laboratory per week, first term.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Design laboratory work will be taken by students in all courses listed above. This will involve the design of machine elements with the object of illustrating the work covered in the lecture subjects in Machine Design. Sketching and drafting will be given with a view to developing the student's judgment and sense of proportion in design and the application of drafting room standards.

Mechanical laboratory work will be taken by Course 3. This will include selected experiments in speed measurement, oil testing, balancing, vibrations, testing of power drives, etc.

469. Machine Design. R. T. Waines.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The design and selection of machinery and equipment met with in metallurgical plants, and in mining work.

Text book: Design of Machine Elements—Faires.

470. Machine Design Laboratory. I. W. Smith, R. T. Waines.

Courses 2, 6 and 8, IV Year; 3 hrs. laboratory per week, second term.

Problems worked out in the laboratory, designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical and metallurgical apparatus, and mine machinery.

471. Machine Design. J. VandeVegte.

Courses 5m, 5n, 5s, 5t, III Year; 1 hr. lecture per week, both terms.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Spotts.

472. Machine Design Laboratory. I. W. Smith, R. T. Waines, J. VandeVegte.

Courses 5m, 5n, 5s, 5t, III Year; 3 hrs. laboratory per week, both terms.

The work in the laboratory will consist of the analytical solution of problems, illustrating the principles involved in the lecture course, and the standard practice in making assembly and detail machine drawings.

473. Machine Design. I. W. Smith.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

This is a continuation of subjects 467 and 466. It will involve the design of various machine elements and equipment including machine frames, hooks, hoisting equipment, crankshafts, gears

(helical, herringbone, bevel, screw, and worm), springs, clutches, brakes, thin and thick wall vessels.

An introduction will be given to the study of vibration problems encountered in high speed engines and machines.

Text books: Design of Machine Elements—Faires. Mechanical Vibrations—Thomson.

474. Machine Design Laboratories. I. W. Smith, R. T. Waines.

Course 3, IV Year; 5 hrs. laboratory per week, both terms.

Advanced laboratory work involves both analysis and design of machine elements, machine units, and complete machines. The selection of problems is made with a view to giving the student as broad a coverage as possible and providing experience in combining of elements to form a machine of smooth and harmonious design. Some of this work will involve special shafting problems including graphical solutions, critical speeds, and multiple supports.

Work will be given in the Mechanical Laboratory on gauging and fine measurements, experimental stress analysis, vibration, and bearing testing.

475. Machine Design. J. VandeVegte.

Course 7, III Year; 2 hrs. lectures per week, first term.

Force analysis; mechanics; velocities, accelerations and inertia forces in machines; principles of stress analysis and the design of various machine elements, including shafting, bearings, belts, gears, etc.; also an introduction to work on speed fluctuation, vibrations and balancing.

Text book: Design of Machine Elements—Spotts.

476. Manufacturing Process Dynamics. D. J. Clough.

Course 4, IV Year; 2 hrs. lectures per week, second term.

The design and control of manufacturing processes and systems.

477. Manufacturing Process Dynamics Laboratory. R. W. P. Anderson, D. J. Clough.

Course 4, IV Year; 3 hrs. laboratory per week, second term.

Laboratory based on subject 476.

478. Machine Design. J. VandeVegte.

Course 5t, IV Year; 2 hrs. lectures per week, second term.

A series of lectures on design methods related to heat engines, including force analysis, speed fluctuation, flywheel design, governors, vibrations, high speed bearings, and thermal stress.

Reference books: Mechanism and Dynamics of Machinery—Mabie and Ocvirk. Analysis and Lubrication of Bearings—Shaw and Macks. Design of Machine Elements—Spotts.

479. Machine Design. R. T. Waines.

Course 6, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The design of various machine elements, particularly those likely to be met with in chemical plants, and an outline of the

properties, production methods, and selection of materials used in machine equipment.

Reference books: Process Equipment Design—Hesse and Rushton. Principles of Machine Design—Berard, Waters and Phelps. Design of Machine Elements—Faires.

480. Elementary Control Theory. J. M. Ham, C. H. Miller, A. Porter, J. VandeVegte.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

System characteristics, including response, feedback and control; equivalence of functioning elements; sensing elements; criteria for selection.

481. Elementary Control Theory Laboratory. J. M. Ham, C. H. Miller, A. Porter, O. Schmidt, J. VandeVegte.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Problems and laboratory experiments related to subject 480 are dealt with.

482. Machine Design.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

Force analysis; mechanics, velocities, accelerations and inertia forces in machines; stress analysis; deflections; failure theory; fluctuating stress, and design of various machine elements including shafts, bearings, belts, gears, riveted and welded parts, etc.; also an introduction to speed fluctuation and vibrations.

Text Book: Design of Machine Elements (third edition)—M. F. Spotts.

MATHEMATICS

490. Calculus. D. R. Breach, R. R. Burnside, P. B. Chapman, D. R. Miller, R. A. Ross, C. J. Scriba, S. Trott.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

Derivation of the fundamental formulas of the differential and integral calculus, with applications to problems concerning curves, areas, volumes, lengths. Problems are dealt with in the drafting room as outlined in subject 275.

491. Calculus. B. Abrahamson, J. B. Leicht, K. B. Ranger, C. F. Schubert.

Courses 1, 2, 3, 4, 6, 8 and 9, II Year; 2 hrs. lectures per week, both terms.

Continuation of subject 490. The elementary theory reviewed and extended, with special attention to applications in engineering. Introduction to simple differential equations. Problems are dealt with in the drafting room as outlined in subjects 284, 285, 286, 287, 288 and 289.

492. Analytical Geometry. D. R. Breach, R. R. Burnside, P. B. Chapman, D. R. Miller, R. A. Ross, C. J. Scriba, S. Trott.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 1 hr. lecture per week, both terms.

The Secondary School course in the geometry of the plane is extended and is followed for the greater part of the session by an algebraic treatment of the geometry of planes, lines, and quadric surfaces. Problems are dealt with in the drafting room as outlined in subject 275.

493. Calculus and Differential Equations. W. Kahan.

Course 7, II Year; 2 hrs. lectures per week, both terms. 2 hrs. computation per week, both terms.

The definite integral, expansion in series, ordinary differential equations, partial differentiation, multiple integration and an introduction to partial differential equations.

494. Least Squares.

Course 1B, III Year; 3 hrs. laboratory per week, first term. (Not given in 1962–63.)

The general principles of probability of errors, elementary problems illustrating the application of Least Squares to the adjustment of observations, empirical constants and formulae.

No laboratory reports shall be written outside the assigned teaching hours.

Text books: Least Squares in Engineering—Marshall and Macklin.

495. Mathematical Problems. W. J. R. Crosby, K. B. Ranger, D. K. Sen, W. J. Webber, R. Wormleighton.

Course 5, II Year; 3 hrs. problems per week, both terms.

The weekly sheet of prepared problems will be based on the content of courses 501, 504, 505, and will provide training in operating the routine processes of the Calculus and will illustrate these by applications in Numerical Methods, Mechanics and Geometry. Students will be given an opportunity to have their difficulties in these courses cleared up.

501. Probability and Numerical Methods. R. Wormleighton.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Definition of probability; binomial, Poisson, and normal distributions; frequency; sampling distributions. Examples of estimation, hypothesis testing, control charts, regression, and analysis of variance. Finite differences; operators; interpolation; numerical integration and solution of equations; inversion of matrices.

502. Algebra and Geometry. D. A. Clarke, Mrs. C. C. Krieger-Dunaj.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Complex numbers, elementary theory of equations, rational functions, vectors and matrices, coordinate systems, planes, lines, standard surfaces of the second degree, principal axes.

503. Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Introduction of differential and integral calculus with applications; limits, power series, the exponential and logarithmic functions; trigonometric and hyperbolic functions and their inverses.

Text books: Calculus—Sherwood and Taylor. Introduction to the Calculus—Beatty and Jenkins.

504. Differential Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Ordinary and partial differentiation, differentials, Taylor's theorem for functions of one or more variables, maxima and minima, transformations, convergence and uniform convergence, differential equations of the first order, linear differential equations with constant coefficients.

Text book: Advanced Calculus—Sokolnikoff.

505. Integral Calculus. W. J. Webber, K. B. Ranger.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Methods of indefinite integration, definite integrals, multiple integrals, line and surface integrals, orthogonal functions.

Text book: Advanced Calculus—Sokolnikoff.

507. Differential Equations. B. Brainerd, R. A. Ross.

Courses 1, 6 and 8, III Year; 1 hr. lecture per week, both terms.

First order equations solvable by quadratures, linear equations of first and second orders, linear equations with constant coefficients of higher order.

Text books: Elementary Differential Equations—Kells. Differerential Equations—Reddick.

508. Theory of Functions. Mrs. C. C. Krieger-Dunaj.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

Complex numbers, limits and series, analytic functions, Cauchy's theorem, Taylor and Laurent series, singularities and their significance, analytic continuation, contour integration, conformal mapping of one plane region on another.

Text books: Functions of a Complex Variable—Phillips. Theory of Functions—Copson. Theory of Functions as applied to Engineering Problems—Rothe, Ollendorf, and Pohlhausen. Introduction to Complex Variables and Applications—Churchill.

509. Differential Equations. Mrs. C. C. Krieger-Dunaj.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation with constant coefficients, operator

methods, the linear partial differential equation, particular equations of the second order.

Text books: Differential Equations—Piaggio. Intermediate Differential Equations—Rainville. Fourier Series and Boundary Value Problems—Churchill.

510. Statistics. K. Hastings.

Course 8, IV Year; 2 hrs. lectures per week, first term.

An introduction to the statistical methods used in the analysis and control of production processes.

511. Differential Equations. P. B. Chapman, D. R. Miller.

Courses 3 and 4, III Year; 2 hrs. lectures per week, both terms.

Course 3, III Year; 1½ hrs. problems per week, first term; 3 hrs. problems per week, second term.

First and second order ordinary differential equations, operational methods, variation of parameters, solution in series, Fourier series, Bessel and Legendre functions, the Laplace transform, applications to first and second order partial differential equations, applications to problems in fluid flow systems, heat conduction, vibrating systems and stress analysis.

512. Probability and Statistics. D. B. DeLury.

Course 4, II Year; 2 hrs. lectures per week, both terms.

Frequency distributions and probability laws; binomial, Poisson, and normal distributions and the treatment of samples drawn from them; tests of significance and confidence limits; control charts; introduction to the analysis of variance.

513. Probability and Statistics Laboratory. D. B. DeLury.

Course 4, II Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises associated with the material of the companion lecture subjects.

514. Numerical Analysis. K. Hastings.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Vectors, matrices, inversion of matrices, regression theory and calculations, elements of the design of experiments, theory of sampling.

515. Numerical Analysis Laboratory. K. Hastings, E. E. Pickett.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Practice in the numerical analysis methods and techniques dealt with in the lecture subject. Practical problems, as well as problems of a fundamental mathematical nature, will be covered.

516. Differential Equations. Problems. C. A. Wrenshall, W. A. Skirrow.

Course 1, III Year; 1½ hrs. laboratory per week, both terms.

Problems based on the content of Lecture Course 507.

Problems must be done during the laboratory period.

MATHEMATICS, APPLIED

520. Applied Mathematics in Engineering. Staff in Mechanical Engineering.

Course 3, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term; 3 hrs. problems per week, first term; 2 hrs. problems per week, second term.

Dimensional analysis and similarity, numerical methods, relaxation techniques, approximate solutions, digital and analogue computation, introduction to statistics and operations research.

521. Differential Equations of Mathematical Physics. D. Naylor.

Course 5, IV Year; 2 hrs. lectures per week, both terms.

The underlying theory and important particular equations, including eigenvalues and eigenfunctions, Fourier series, spherical and cylindrical harmonics, vibration of strings, membranes, and rods, sound waves, water waves, equation of heat conduction.

Text books: Fourier series and Boundary Value Problems—Churchill. Modern Operational Mathematics in Engineering—Churchill. Partial Differential Equations of Mathematical Physics—Webster.

522. Computational Methods. L. E. Jones.

Course 5t, IV Year; 1 hr. lecture per week, 3 hrs. problems per week, first term.

Practical extension of Subjects 501 and 495 to provide advanced computing experience with desk calculators and with analogue and digital computers. FORTRAN computer language will be studied in detail. Emphasis is placed on the economic use of available numerical procedures in the solution of engineering problems.

523. Adjustment of Observations. H. L. Macklin.

Course 1b, IV Year; 3 hrs. per week, second term. (1962–63 only.)

Problems illustrating the application of Least Squares to the adjustment of observed data, with particular reference to surveying measurements.

No laboratory reports shall be written outside the assigned teaching hours.

524. Operations Research I. R. W. P. Anderson, D. J. Clough, B. Bernholtz.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

Methods for establishing economic optima in industrial operations; mathematical models for allocation of resources, inventory and production; applied probability in machine interference, maintenance and replacement, competition and bidding. Measures of effectiveness, evaluation of objectives, tests of validity.

525. Operations Research I Laboratory. R. W. P. Anderson, D. J. Clough, B. Bernholtz.
Course 4, IV Year; 3 hrs. laboratory per week, both terms.
Practical work to accompany subject 524.

526. Operations Research II. R. W. P. Anderson, D. J. Clough, B. Bernholtz.
Course 4, IV Year; 2 hrs. lectures per week, first term.
Analytical, iterative and statistical procedures used in Operational Research.

527. Operations Research II Laboratory. R. W. P. Anderson, D. J. Clough, B. Bernholtz.
Course 4, IV Year; 3 hrs. laboratory per week, first term.
Practical work to accompany subject 526.

METALLURGICAL ENGINEERING

530. Metallurgy. The Staff in Metallurgy.
Course 8, II Year; 2 hrs. lectures per week, both terms.
An introductory course describing the theory and practice of metallurgical processes and operations.

531. Principles of Extractive Metallurgy. L. M. Pidgeon.
Course 8, III Year; 2 hrs. lectures per week, both terms.
A general discussion of the fundamental principles of extractive metallurgy with reference to the production of the more important metals.

532. Principles of Extractive Metallurgy Laboratory. H. U. Ross, S. N. Flengas.
Course 8, III Year; 3 hrs. laboratory per week, first term; 6 hrs. continuous laboratory per week, second term.
Experiments in pyrometry, furnaces, roasting, smelting, leaching, retorting, refining, electrolysis designed to illustrate the principles underlying these operations.
One laboratory report per week.

533. Principles of Physical Metallurgy. G. B. Craig, W. C. Winegard.
Courses 5m and 8, III Year; 2 hrs. lectures per week, both terms.
A discussion of the structure of solids with particular reference to x-ray methods of investigation; the solidification of metals, and the plastic deformation of metals with reference to the dislocation theory.

534. Principles of Physical Metallurgy Laboratory. W. C. Winegard.
Courses 5m and 8, III Year; 3 hrs. laboratory per week, both terms.
Practical work relating to subject 533.

535. Metallurgical Thermodynamics I. G. B. Craig.
Course 8, III Year; 2 hrs. lecture per week, both terms.
The physico-chemical principles of metallurgy.

536. Metallurgical Problems Laboratory. H. U. Ross, S. N. Flengas, G. B. Craig.
Course 8, III Year; 4 hrs. laboratory per week, both terms.
Problems in chemistry, physical chemistry and thermodynamics as applied to metallurgical processes and operations relating to subjects 531 and 535.

538. Physical Metallurgy. H. U. Ross.
Course 1, II Year; Course 2, IV Year; 2 hrs. lectures per week, second term.
A short course on the structure and mechanical properties of metals and alloys and on the influence of heat and mechanical treatment upon these properties. Reference is made particularly to steels and the more-important non-ferrous alloys. Welding of metals is also included.

539. Metallurgy. H. U. Ross.
Courses 2 and 9, III Year; 1 hr. lecture per week, second term.
An introductory course describing the theory and practice of metallurgical processes and operations.

540. Metallurgical Problems Laboratory. H. U. Ross.
Course 8, II Year; 2 hrs. laboratory per week, second term.
Problems in chemistry and physical chemistry as applied to metallurgical processes relating to subject 530.

550. Non-Ferrous Extractive Metallurgy. L. M. Pidgeon.
Course 8, IV Year; 1 hr. lecture per week, both terms.
Extractive metallurgy of the non-ferrous metals, including electrometallurgy.

551. Ferrous Extractive Metallurgy. H. U. Ross.
Course 8, IV Year; 1 hr. lecture per week, both terms.
Extractive metallurgy of iron and steel.

552. Extractive Metallurgy Laboratory. H. U. Ross, S. N. Flengas.
Course 8, IV Year; 6 hrs. continuous laboratory per week, first term.
A continuation of subject 532.
Four laboratory reports per term.

553. Metallurgical Thermodynamics II. G. B. Craig.
Course 8, IV Year; 2 hrs. lectures per week, both terms.
A study of chemical equilibria at high temperatures in extractive metallurgy.

554. Metallurgical Problems Laboratory. G. B. Craig, S. N. Flengas.
Course 8, IV Year; 2 hrs. laboratory per week, both terms.
Problems relating to subjects 550, 551 and 553.

555. Metallurgy. L. M. Pidgeon.

Courses 2 and 9, IV Year; 1 hr. lecture per week, both terms.

The extractive metallurgy of the common metals, together with the calculations necessary to understand metallurgical processes.

556. Metallurgy Laboratory. H. U. Ross, S. N. Flengas.

Course 2, IV Year; 6 hrs. continuous laboratory per week for one half of second term.

Similar to subject 532.

One laboratory report per week.

557. Physical Metallurgy. W. C. Winegard, G. B. Craig.

Courses 5m and 8, IV Year; 2 hrs. lectures per week, both terms.

A continuation of subject 533 in which the heat treatment of ferrous and non-ferrous alloys is discussed.

558. Physical Metallurgy Laboratory. W. C. Winegard.

Course 8, IV Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.

Practical work relating to subject 557.

561. Physical Metallurgy. E. L. Holmes.

Courses 5a, 5c, 5g, 5n, 5t, III Year; 1 hr. lecture per week, both terms.

A short course in Physical Metallurgy; structure of metals and alloys; effects of mechanical distortion and heat treatment on structure; relation between structure and mechanical properties; and properties of some steels and non-ferrous alloys.

562. Physical Metallurgy Laboratory. W. C. Winegard.

Course 5m, IV Year; 3 hrs. laboratory per week, second term.

Practical work relating to subject 557.

563. Physics of Metals Seminar. G. B. Craig, W. C. Winegard.

Course 5m, IV Year; 3 hrs. per week, both terms.

Each student prepares and presents seminars on topics concerning metal physics. The topics may include nucleation theory, dislocations, imperfections, electron theory, ferromagnetism, phase transformations, electrical properties, grain boundaries, metal surfaces, thermal properties, diffusion or any topic satisfactory to both staff and student.

564. Physical Metallurgy. W. C. Winegard.

Courses 3 and 4, II Year; 2 hrs. lectures per week, both terms.

A general course in Physical Metallurgy, dealing with the structure of metals and alloys, with special reference to the ferrous alloys of practical importance. The influence of mechanical deformation, heat treatment, and composition on the structure is considered, and the relation between the structure and mechanical properties is examined.

565. Physical Metallurgy Laboratory. W. C. Winegard.

Courses 3 and 4, II Year; 3 hrs. laboratory per week for six weeks, second term.

A practical course illustrating the principles dealt with in subject 564. Experiments are conducted on the heat-treatment of ferrous and non-ferrous alloys.

566. Physical Metallurgy. E. L. Holmes.

Courses 5e and 7, III Year; 2 hrs. lectures per week, second term.

A short course in physical metallurgy which includes the structure of solids, the liquid-solid transformation, phase diagrams, defects in the solid state, the effect of stress and temperature on metals and the relationship between structure and properties. Commercial alloys are discussed in terms of the above topics.

567. Physical Metallurgy Laboratory. W. C. Winegard.

Courses 5e and 7, III Year; 1½ hrs. laboratory per week, second term

Experiments are conducted to illustrate the essential features of subject 566. These include the examination of metals by metallographic and x-ray diffraction techniques.

MODERN LANGUAGES

610. English.

All Courses, I Year; 1 hr. lecture per week, both terms.

A course in essay writing, based on the study of examples of expository prose. Texts will be announced at the opening of the session.

611. English Literature.

All Courses, IV Year; 1 hr. lecture per week, both terms.

A course in the drama, the novel and poetry based on the study of the following texts: Shaw, *Man and Superman* (Longmans); Twain, *Huckleberry Finn: Text, Sources, and Criticism* (Harcourt Brace); Snow, *The New Men* (Penguin); Joyce, *Portrait of the Artist as a Young Man* (Compass); two plays to be announced in September; an anthology of poetry to be announced in September.

Students are expected to read the four works named above during the summer preceding their entry into the Fourth Year. Term work will include assignments based on texts read during the summer, one substantial essay, and two class tests. Students who obtain a satisfactory term mark will not be required to write a final examination.

PHYSICAL EDUCATION

640. Physical Education.

All courses, I Year.

By order of the Board of Governors each first year student

must register for, and satisfactorily complete, the University requirement in Physical Education. This requirement includes a medical examination by the University Health Service. Each year of failure to fulfil the regulations renders the student liable to a special fee of $50.00.

Physical Education credits may be earned by participation in intercollegiate and intramural sports, swimming, water safety, and instructional classes.

Exemptions: (1) one year's satisfactory standing in physical education at this or any other University (2) if age is 30 years or more (3) ex-military service (4) completion of one year's course in the U.N.T.D., C.O.T.C. or U.R.T.P. (5) exemption by the University Health Service (6) special consideration.

PHYSICS

650\. Properties of Matter; Mechanics and Heat. D. G. Ivey.

Course 5, I Year; 3 hrs. lectures per week, both terms.

Text book: Mechanics, Heat and Sound—Sears.

651\. Physics Laboratory. D. G. Ivey, Miss K. M. Crossley and the staff in Physics.

Course 5, I Year; 3 hrs. laboratory per week, both terms; 1 hr. tutorial per week, both terms.

To accompany subject 650.

Twelve laboratory reports.

652\. Physics. J. N. P. Hume.

Course 5, II Year; 3 hrs. lectures per week, both terms.

Fundamental theory of electricity and magnetism. Acoustic and electromagnetic waves. Interference, diffraction and polarization of light waves. Elementary atomic physics.

655\. Physics Laboratory. J. N. P. Hume.

Course 5, II Year; 3 hrs. laboratory per week, both terms.

To accompany subject 652.

656\. Physics of Solids and Fluids. R. W. McKay.

Courses 5e, 5g, 5m, 5p, III Year; 1 hr. lecture per week, both terms.

Elasticity, viscosity, equations of fluid motion, wave propagation, heat conduction, potential theory.

657\. Thermodynamics and Kinetic Theory. J. C. Stryland.

Course 5, III Year; 2 hrs. lectures per week, both terms.

The fundamental principles of thermodynamics, kinetic theory, and statistical mechanics.

659\. Physics Laboratory. J. C. Stryland.

Course 5, III Year; 3 hrs. laboratory per week, both terms.

To accompany subjects 656 and 657.

Twelve laboratory reports.

660. Atomic Structure and Quantum Physics.

Courses 5n and 5p, III Year; 2 hrs. lectures per week, both terms.

Waves and particles; Schrodinger equation; harmonic oscillator, hydrogen and helium atom, many-electron atoms; nuclear structure; radiactivity; interaction of radiation with matter.

Text books: Weidner and Sells, Elementary Modern Physics; Leighton, Principles of Modern Physics.

662. Nuclear Physics. K. G. McNeill.

Courses 5n, III Year; 1 hr. lecture per week, both terms.

Neutron physics, nuclear radiation detection techniques, introduction to reactor theory and shielding problems, health physics.

663. Atomic Physics. Miss E. J. Allin, K. G. McNeill, H. L. Welsh.

Courses 5e, 5c, 5g, 5m, 5n, 5p and 5t, IV Year; 3 hrs. lectures per week, both terms.

Introduction to quantum theory, atomic, molecular and nuclear physics.

664. Nuclear Engineering. D. G. Andrews, R. E. Jervis.

Course 5n, IV Year; 1 hr. lecture per week, both terms.

Reactor kinetics, heat transfer problems in a reactor. Nuclear chemistry, techniques and applications.

665. Physics Laboratory. The staff in Physics.

Course 5p, IV Year; 9 hrs. laboratory per week, both terms.

Courses 5c, 5m and 5n, IV Year; 6 hrs. laboratory per week, both terms.

To accompany the lecture subjects 663, 664, 666, and 669.

666. Optics II. H. L. Welsh.

Course 5p, IV Year; 2 hrs. lectures per week, both terms.

Polarization, diffraction, coherence and quantum effects.

Text books: Fundamentals of Optics—Jenkins and White. Principles of Optics—Born and Wolf. Optics of the Electromagnetic Spectrum—Andrews.

669. Introductory Quantum Mechanics. J. Van Kranendonk.

Course 5p, IV Year; 1 hr. lecture per week, both terms.

Text books: Elementary Wave Mechanics—W. Heitler. Introduction to Quantum Mechanics—L. Pauling and E. B. Wilson.

670. Theory and Application of Geophysical Methods. R. M. Farquhar.

Course 5g, IV Year; 2 hrs. lectures per week, both terms.

A course on the mathematical theory of magnetic, electrical, seismic and gravitational methods in applied geophysics.

671. Exploration Geophysics. R. M. Farquhar.

Course 9, IV Year; 1 hr. lecture per week, both terms.

An introduction the physical principles underlying the important methods of geophysical prospecting. Particular attention

is given to seismic, gravitational, magnetic and electromagnetic methods.

Text book: Introduction to Geophysical Prospecting—Dobrin.

672. Geophysics. F. Grant.

Course 5g, IV Year; 6 hrs. laboratory per week, both terms.

To accompany subject 670.

673. Geophysics. G. F. West.

Course 9, IV Year; 3 hrs. laboratory per week, both terms.

To accompany subject 671.

674. Physics of the Earth. J. T. Wilson.

Course 5g, III Year; 1 hr. lecture per week, both terms.

Introduction to gravitation, the figure of the Earth and isotasy, seismology and the internal constitution of the Earth; radioactivity, geothermal heat and the age of the Earth, tectonics of the Earth's crust, with special reference to geological aspects.

Text books: Physics and Geology—Jacobs, Russell and Wilson.

675. Physics of the Earth. D. York.

Course 5g, IV Year; 2 hrs. lectures per week, second term.

Physical theories of seismology and the internal constitution of the Earth, gravity and the figure of the Earth, temperature and thermal history, geomagnetism and physics of the upper atmoshere, glaciology, mechanical properties of the Earth's interior.

Text books: Physics and Geology—Jacobs, Russell and Wilson. The Earth—Jefferys.

676. The Structure and Properties of Matter. J. N. P. Hume, J. D. Prentice, A. D. May, J. D. Poll.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

An introduction to the mechanical, electrical, magnetic, thermal and optical properties of matter in terms of atoms.

677. Physics Laboratory. The Staff in Physics, Civil Engineering and Electrical Engineering.

Twenty-four 3-hour periods of laboratory or problem work, twelve of which are devoted to experiments in the Physics Laboratory, six to experiments in the Electrical Laboratory and six to problems in Applied Mechanics.

All work must be completed within the assigned laboratory hours.

678. Engineering Data Processing. C. C. Gotlieb, B. H. Worsley.

Course 4, IV Year; 2 hrs. lectures per week, second term.

A course in programming and coding for the digital computer.

679. Engineering Data Processing Laboratory. C. C. Gotlieb, B. H. Worsley.

Course 4, IV Year; 3 hrs. laboratory per week, second term.

Practical work to accompany subject 678.

PRACTICAL EXPERIENCE

690. Practical Experience.

Students in the courses listed below are required to have, before graduation, practical work of a nature acceptable to the department concerned. This may be obtained during the summer vacations but work done before entering the Faculty may also meet the requirements. Instructions will be issued by the departments concerning the type of work which is acceptable. Practical experience certificate forms may be obtained from the departments and should be returned there when completed.

Course 1	600 hours
Course 2	6 months
Course 3	1200 hours
Course 4	1200 hours
Course 6	800 hours
Course 7	1200 hours
Course 8	800 hours
Course 9	6 months

SURVEYING

All students taking Field Work in subjects 710 to 721, inclusive, will be required to use Departmental Field Books.

No laboratory reports shall be written outside the assigned teaching hours.

710. Surveying. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 1, 2 and 9, I Year; 1 hr. lecture per week, first term.

General principles and practice of surveying with the tape, the transit, and the level, and computation of corrections, azimuths, bearings, latitudes and departures, co-ordinates and areas.

Text book: Surveying—Philip Kissam.

Reference books: Plane Surveying—Tracy. Elementary Surveying—Breed and Hosmer. Surveying—Breed.

712. Field Work. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 1, 2 and 9, I Year; 3 hrs. per week, first term.

Practice in chaining; keeping of field notes; the use of the transit in surveying closed figures and traverse lines; plotting by co-ordinates; computing of areas; instrumental work with the level and calculating the volume of excavations.

714. Surveying. O. J. Marshall, B. J. Haynes.

Course 1, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Simple, reverse, compound and spiral curves as applied to Highway and Railroad surveying. Main features of mine and hydrographic surveying. Construction surveying dealing with cross sectioning, earthwork, quantities, mass or haul diagram,

super elevation, vertical curves, and layout of roads and sewers.
Text book: Route Surveys—Skelton.

715. Surveying. H. L. Macklin.

Courses 2 and 9, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Mine surveying, with problems related thereto. Simple curves, stadia and plane table topographical surveying. Practical determination of time, latitude and azimuth by methods adapted to the surveyor's transit.

Text book: Surveying for Civil Engineers—Kissam.

716. Surveying Laboratory. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Course 1, II Year; 3 hrs. per week, both terms.

First term: Field problems, in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy, and earth work quantities.

717. Surveying Laboratory. H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 2 and 9, II Year; 3 hrs. per week, first term; 2 hrs. per week, second term.

First term: Field problems in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy and mine problems.

720. Survey Camp. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Course 1, III Year; Aug. 13 to Sept. 15; Courses 2 and 9, III Year; Aug. 20 to Sept. 15—Gull Lake or Dorset.

Course 1:

(*a*) Secondary Triangulation and Base Line Measurements.
(*b*) Highway and Railway Location.
(*c*) Cross Sectioning and Computation of Earthwork.
(*d*) Stadia and Plane Table Topography.
(*e*) Observations for Time, Azimuth, and Latitude.

Courses 2 and 9:

(*a*) Stadia and Plane Table Topography.
(*b*) Mine Surveying, using overhead stations.
(*c*) Shaft plumbing and use of Auxiliary Telescope.

Students in Courses 1, 2 and 9 will be required to take the Survey Camp between the Second and Third Years; on failure to do so, this subject will be carried as a supplemental in the Third Year.

Application to defer attendance at the Camp must be made to the Secretary of the Faculty before July 15th.

721. Survey Camp. O. J. Marshall, B. J. Haynes.

Course 1b, IV Year; Sept. 4 to Sept. 15 (2 weeks) Dorset.

Triangulation, traverses, levelling and astronomical observations by precise methods.

THESIS

730. Thesis.

All courses, IV Year.

Every student in the Fourth Year is required to prepare a thesis on an approved subject. Instructions will be issued by the departments concerned.

In some cases written presentation is required, in others oral and written, or it may consist of a research problem followed by a written thesis or report.

SECTION IX. EXAMINATIONS

ANNUAL EXAMINATIONS

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations and laboratory work in each subject is 50% and a student must obtain a weighted average of 60% in order to pass in the work of the year. (In the First Year of the course in Engineering Science, an average of 66% or over is required for promotion in that course. For special regulations concerning Engineering Science, see page 45 of this Calendar.) He shall be required to pass a supplemental examination in each subject in which he obtains less than 50%. Subjects will be weighted according to the number of hours devoted to them, the hours assigned to laboratory subjects being given one half the weight of those in lecture subjects.

5. Honours and scholarships will be awarded upon the basis of the weighted average.

6. Honours will be awarded to a student, who at the Annual Examinations passes in all written and laboratory subjects and who also obtains a weighted average of 75% on the work of the year.

7. Honour graduate standing will be granted to those who obtain honours in the final year and in one previous year.

8. A student who fails in the work of any year will be permitted, unless otherwise ineligible, to register in a subsequent session for the purpose of repeating the year, subject to the following conditions:

- (a) Only one such repetition will be allowed in the student's entire undergraduate course. A failure in an engineering course at any other institution will be counted in the same way as a failure at this university.
- (b) During any such repetition, the full programme of prescribed instruction must be taken.
- (c) Second, Third, or Fourth Year work may be repeated in the session immediately following that in which the failure occurs.
- (d) A student who fails in the work of the First Year but who obtained an average of 55% or over will, provided he is otherwise eligible, be allowed to repeat the work of the year in the following Session. All other students who fail in the work of the First Year must remain out for one Session before re-applying. If a student withdraws on or before 15th February he may re-apply for admission the following Session.

  Any student re-applying for admission to the First Year must

file a new application (as outlined in Paragraph 6, Section V) with the Registrar of the University.

9. A student who has twice failed the work of his first year at this or another university shall not be granted admission to any course.

10. A student whose attendance at lectures or laboratories, or whose work, is deemed by the Council of the Faculty in which he is registered, to be unsatisfactory, may have his registration cancelled at any time by the Council of the Faculty.

11. A student should submit to Council immediately after its occurrence, evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

12. A student will not be allowed to write any examinations if he has not paid all fees and dues for which he is liable at that time.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on August 7, 1962. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 9, and the fee named in Sec. VI, para. 11, received by the Chief Accountant not later than July 27. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements.

2. If a candidate desires to write upon an annual examination as a supplemental, his application must be received by the Secretary and his fee by the Chief Accountant, for the January examinations not later than December 1 and for the April examinations not later than March 1.

3. Except under very exceptional circumstances, pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by the order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

EXTRA-CURRICULAR ACTIVITIES AND ACADEMIC CREDIT

It is in general desirable for students to engage to a reasonable extent in extra-curricular activities in order that they may not become too narrowly professional in interests and outlook, but it will be obvious that no academic credit or consideration can be given for such activities. Some offices in student organizations require quite large amounts of time for the proper performance of the duties connected with them, and it is therefore strongly recommended that students, particularly those whose academic records are not high, consult a senior member of Staff before allowing themselves to be nominated for such offices.

SECTION X. MEDALS, PRIZES, SCHOLARSHIPS, BURSARIES AND FELLOWSHIPS

Through the generosity of friends of the University, governments and commercial organizations, encouragement has been given to both undergraduate and graduate work in the various branches of engineering studies by establishing the following scholarships, prizes, bursaries, and medals.

Matriculation students are advised to consult the University of Toronto Calendar of Admission Awards for complete details of awards available to students entering this Faculty.

Where it is necessary to make application for an award it is so stated in the description and particulars are given as to how the application should be made. In all other cases the award is made on the recommendation of the Faculty Council and no application is necessary.

In order to be eligible for a medal, prize, scholarship, bursary, fellowship or other awards granted solely upon standing obtained at an annual or special examination or upon an essay, or term work, or other academic rating, a candidate must obtain honours at such annual or special examination or upon such essay, term work, or other academic rating unless the terms of the award or medal specify that standing lower than honours may be accepted.

When an award or medal is granted upon standing obtained on part of the work of any academic year the candidate must obtain standing but need not obtain honours in the work of the academic year as a whole, provided he obtains honours in the part concerned, unless the terms of the award or medal specify otherwise.

No medal, prize, scholarship, bursary, fellowship or other award will be granted to a candidate who is conditioned in any subject at an annual examination or in Physical Education unless the terms of the award or medal specify otherwise.

A candidate will not be permitted to receive more than one award in a session unless the statute establishing each of the awards concerned or the Calendar specifies otherwise. Only one of those marked by an asterisk may be held in any one year. A candidate who would, but for this provision, have received more than one award may have his name so published in the class lists.

A candidate who has spent two sessions in any year of an undergraduate course is not eligible to compete for any award at the annual examinations of that year.

Medals, after they have been suitably engraved, will be given without delay to the winners or forwarded to them by registered mail.

Awards granted to members of graduating classes other than awards for graduate study and research, will be paid in one instalment as soon as possible after the granting of the awards.

All other awards will be paid (i) if of the value of $100 or less, in one instalment on November 20 and (ii) if of the value of more than $100 in two equal instalments, the first on November 20 and the second on

January 20, in the session following the granting of the awards provided that no payment is made to a candidate (*a*) who is not in regular attendance upon lectures and laboratory classes in the Faculty, or if the Calendar so specifies, in the course in which the award is established or granted (*b*) who does not present at the Chief Accountant's Office before each payment a certificate of attendance upon lecture and laboratory classes signed by two senior members of the staff.

The Senate may, on the recommendation of the Faculty, permit a candidate to whom an award has been granted to postpone attendance upon lectures and laboratory classes for one year. Further postponement may be permitted on application.

Name	Amount	Application required	Available only to a limited group or single course	See page
AVAILABLE TO STUDENTS ENTERING THE FIRST YEAR				
The Alcan Scholarship........	$500	Yes	No	136
J. P. Bickell Foundation Scholarships...............	$500	Yes	No	139
The J. W. Billes Admission Scholarships...............	—	Yes	No	140
Dominion Magnesium Limited Bursary...................	$400	Yes	Yes	141
Dominion-Provincial Student Aid Bursaries, Type A......	—	Yes	No	142
Engineering Alumni Admission Bursaries.	—	Yes	No	143
Engineering Alumni Admission Scholarship...............	$500	Yes	No	143
The Grabill Admission Scholarship...............	$400	Yes	No	145
Hagarty Memorial Scholarship.	$60	Yes	Yes	145
The Murray Calder Hendry Scholarship...............	$500	Yes	No	146
Inco Scholarship	$300 + Fees	Yes	No.	147
The Leonard Foundation Scholarships..............	—	Yes	Yes	148
J. Edgar McAllister Foundation	—	Yes	Yes	149
O.H.A. War Memorial Scholarship................	$200	Yes	Yes	153
Ontario Chapter American Society for Metals Bursary..	$400	Yes	Yes	137
A.P.E.O. Admission Scholarship	$500	Yes	No	155
The Helen E. Rogers Admission Scholarships......	—	Yes	Yes	157
Simpson-Sears Limited (Northern Ontario) Scholarship.....................	$100	Yes	Yes	158

Name	Amount	Application required	Available only to a limited group or single course	See page
Smith and Stone Limited Bursaries..................	$150	Yes	Yes	159
Students' Administrative Council Admission Scholarship....	$300	Yes	Yes	160
U.T.S. Engineering Scholarship.	$250	Yes	Yes	161
Wallberg Admission Scholarships (2)..................	$500	Yes	No	162
AVAILABLE TO STUDENTS COMPLETING THE FIRST YEAR				
American Society for Metals Foundation for Education and Research Scholarship....	$500	No	Yes	137
Atkinson Incourse Bursaries...	—	Yes	No.	138
Babb Bursary Fund..........	—	Yes	Yes	138
Baptie Scholarship...........	—	No	Yes	138
Canadian Bechtel Limited Bursaries.................	—	Yes	No	139
J. P. Bickell Foundation Scholarships...............	—	No	No	139
T. H. Bickle Prize............	$30	No	Yes	140
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	142
*John M. Empey Scholarship...	$100	No	No	142
*Hydro-Electric Power Commission Scholarship.........	$300	No	No	147
I.B.M.—Thomas J. Watson Memorial Bursary Fund.....	—	Yes	No	147
Inco Scholarship.............	—	Yes	Yes	147
Johnson's Wax Scholarship....	$600	No	Yes	147
Kimberly-Clark Scholarship ...	$500	No	No	148
John Wolfe McColl Awards....	—	Yes	No.	149
Garnet W. McKee-Lachlan Gilchrist Scholarship in Engineering Physics........	$60	No	Yes	150
MacLennan-LacLeod Memorial Prize.................	$25	No	No	151
*Marsland Engineering Ltd. Scholarship................	$250	No	Yes	152
Orenda Engines Scholarship ...	$500	No	Yes	154
*Paulin Memorial Scholarship...	$425	No	Yes	154
Procter and Gamble Bursary..	—	Yes	No	155
*Professional Engineers Scholarship	$250	No	Yes	155

Name	Amount	Application required	Available only to a limited group or single course	See page
*Ransom Scholarship in Chemical Engineering	$150	No	Yes	156
Frederick W. Schumacher Scholarship	—	Yes	Yes	157
S. Ubukata Fund	—	Yes	Yes	160
University Alumni Association War Memorial Scholarships	—	Yes	No	161
University Naval Training Division Bursaries	$100	Yes	Yes	161
University of Toronto General Bursaries	—	Yes	No	161
*Wallberg Undergraduate Scholarships (2)	$500	No	No	162
AVAILABLE TO STUDENTS COMPLETING THE SECOND YEAR				
*Harvey Aggett Memorial Scholarship	$75	No	No	136
Ardagh Scholarship	$220	No	Yes	138
Automotive Transport Association Bursary	—	Yes	No	138
Babb Bursary Fund	—	Yes	Yes	138
Canadian Bechtel Limited Bursaries	$1200	Yes	No	139
J. P. Bickell Foundation Bursaries	—	Yes	Yes	140
J. P. Bickell Foundation Scholarships	—	No	Yes	139
T. H. Bickle Prize	$30	No	Yes	140
Carveth Metallurgical Ltd. Bursary	$500	Yes	Yes	141
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	142
*John M. Empey Scholarship	$100	No	No	142
J. A. Findlay Scholarship	—	No	Yes	144
Hugh Gall Award	$140	Yes	No	144
*Hydro-Electric Power Commission Scholarship	$300	No	No	147
I.B.M.—Thomas J. Watson Memorial Bursary Fund	—	Yes	No	147
Johnson's Wax Scholarship	$600	No	Yes	147
The Kennecott Copper Award in Industrial Engineering	$1000	Yes	Yes	148
Kimberly-Clark Scholarship	$500	No	No	148

Name	Amount	Application required	Available only to a limited group or single course	See page
The Lever Brothers Scholarships	$300	No	Yes	148
*Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarships	—	No	Yes	150
Charles Gordon Manning Prize	—	No	No	151
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	152
W. G. Millar Memorial Scholarship	$250	Yes	Yes	152
James L. Morris Memorial Prize	$125	No	Yes	153
Northern Electric Undergraduate Scholarship	$500	No	Yes	153
Orenda Engines Scholarship	$500	No	Yes	154
*Spruce Falls Power and Paper Company Scholarships	$400	No	No	153
William Storrie Memorial Scholarship	$100	No	Yes	159
*Professional Engineers Scholarship	$250	No	Yes	155
*Rhodes Scholarship	£400	Yes	No	156
Scottish Rite Masons Bursary	$400	Yes	Yes	158
Frederick W. Schumacher Scholarship	—	Yes	Yes	157
Edith Tyrrell Memorial Bursary	$500	Yes	Yes	160
University Alumni Association War Memorial Scholarships	—	Yes	No	161
University of Toronto General Bursaries	—	Yes	No	161
*Wallberg Undergraduate Scholarships	500	No	No	162
*William R. Worthington Memorial Scholarship	$400	No	Yes	162
AVAILABLE TO STUDENTS COMPLETING THE THIRD YEAR				
Allied Chemical Canada Limited Scholarship	$850	No	Yes	137
American Institute of Industrial Engineers Scholarship	$100	No	Yes	137
Babb Bursary Fund	—	Yes	Yes	138
F. W. Baldwin Prize	$75	No	Yes	138

Name	Amount	Application required	Available only to a limited group or single course	See page
Canadian Bechtel Limited Bursaries	—	Yes	No	139
J. P. Bickell Foundation Bursaries	—	Yes	Yes	140
T. H. Bickle Prize	$30	No	Yes	140
*Boiler Inspection and Insurance Company Scholarship	$150	No	Yes	140
*California Standard Company Scholarship	$400	No	Yes	141
Chemical Institute of Canada Prize	$25	No	Yes	141
Archie B. Crealock Memorial Prize	$50	No	Yes	141
Dow Chemical of Canada Limited Award	$500	No	Yes	142
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	142
*John M. Empey Scholarship	$100	No	No	142
E.I.C. Prize	$50	No	Yes	143
Engineering Society Semi-Centennial Award	$75	No	No	144
J. A. Findlay Scholarship	—	No	Yes	144
Chester B. Hamilton Scholarship	$500	No	Yes	145
Hudson Bay Mining and Smelting Company Limited Scholarships	$800	Yes	Yes	146
*Hydro-Electric Power Commission Scholarship	$300	No	No	147
I.B.M.—Thomas J. Watson Memorial Bursary Fund	—	Yes	No	147
*Jenkins Scholarship in Engineering	$200	No	No	147
Johnson's Wax Scholarship	$600	No	Yes	147
The Kennecott Copper Award in Industrial Engineering	$1000	Yes	Yes	148
The Lever Brothers Scholarship	$300	No	Yes	148
Loan Funds	—	Yes	No	170
J. A. D. McCurdy Prize	$75	No	Yes	149
Alexander MacLean Scholarship	$250	No	Yes	151
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	152

Name	Amount	Application required	Available only to a limited group or single course	See page
Mobil Oil of Canada Limited Scholarship	$400	No	Yes	152
Northern Electric Undergraduate Scholarship	$500	No	Yes	153
Orenda Engines Scholarship	$500	No	Yes	154
*Professional Engineers Scholarship	$250	No	Yes	155
Rhodes Scholarship	£400	Yes	No	156
RCE Memorial Scholarship	$125	Yes	Yes	157
Frederick W. Schumacher Scholarship	—	Yes	Yes	157
William Storrie Memorial Scholarship	$100	No	Yes	159
*Spruce Falls Power and Paper Company Scholarships	$400	No	No	153
Edith Tyrrell Memorial Bursary	$500	Yes	Yes	160
University Alumni Association War Memorial Scholarships	—	Yes	No	161
University of Toronto General Bursaries	—	Yes	No	161
*Wallberg Undergraduate Scholarships	$500	No	No	162
AVAILABLE TO STUDENTS COMPLETING THE FOURTH YEAR				
Henry G. Acres Medal	—	No	Yes	136
American Society of Lubrication Engineers Prize	$75	No	No	137
J. P. Bickell Foundation Bursaries	—	Yes	Yes	140
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	142
Electrical Manufacturing Co. Limited Prize	$25	No	Yes	142
Encyclopaedia Britannica Prize	—	No	No	143
Hamilton Watch Award	—	No	No	146
Ontario Chapter, A.S.H.R.A.E. Prize	$75	No	No	146
Johnson Foundation Scholarship Award	—	Yes	Yes	165
Loan Funds	—	Yes	No	170
Massey-Ferguson Ltd. Scholarships (2)	$500	Yes	Yes	152

Name	Amount	Application required	Available only to a limited group or single course	See page
Ontario Municipal Electric Association Bursary	$300	Yes	Yes	154
Professional Engineers Gold Medal	—	No	No	155
William Storrie Memorial Scholarship	$200	No	Yes	159
Society of Chemical Industry Merit Award	—	No	Yes	159
"Second Mile Engineer" Award	$100	No	Yes	158
Trane Company of Canada Limited Prize	$200	No	No	160
University of Toronto General Bursaries	—	Yes	No	161
AVAILABLE TO GRADUATES				
Aluminium Laboratories Limited Fellowship	—	Yes	Yes	162
Athlone Fellowships	—	Yes	No	162
C.I.L. Fellowships in Chemistry	$4000	Yes	Yes	163
Canadian Lumbermen's Association Timber Research Fellowship	$1250	Yes	No	163
Commonwealth Scholarships	—	Yes	No	163
1851 Exhibition Science Research Scholarships	£275	Yes	Yes	164
Imperial Oil Graduate Research Fellowships	$4000	Yes	Yes	165
International Nickel Graduate Research Fellowships	$2000	Yes	Yes	165
S. C. Johnson Foundation Scholarship Award	—	Yes	Yes	165
McCharles Prize	$1000	No	No	166
The University of Manchester Toronto Fund	£100	Yes	No	166
National Sewer Pipe Limited Scholarship	$500	Yes	Yes	167
Nipissing Mining Research Fellowships	$975	Yes	No	167
H. W. Price Research Fellowship in Electrical Engineering	—	Yes	Yes	167
Raymond Priestley Fellowship	£450	Yes	No	167
Rhodes Scholarship	£400	Yes	No	156

Name	Amount	Application required	Available only to a limited group or single course	See page
Royal Institution of Great Britain Science Research Scholarships	£350	Yes	No	168
Steel Company of Canada, Ltd., Fellowship	$1500	Yes	Yes	168
Spruce Falls Power and Paper Company Fellowships	$1200	Yes	No	168
1940 Toronto Fund	£500	Yes	No	168
Wallberg Research Fellowships	$6000	Yes	No	169
Charles G. Williams Fellowship	$1500	Yes	Yes	169
Garnet W. McKee Loan and Scholarship Fund	$800	Yes	Yes	169

NOTE—As the value of an endowed scholarship or prize is dependent on the actual income of the fund, it is possible that the value of certain scholarships and prizes at the time of payment may be less than the amount stated in the calendar.

In those cases where the amount of the award is not payable from income earned on an endowed fund, payment will be dependent on the receipt of the amount of the annual award from the donor.

HENRY G. ACRES MEDAL

The Henry G. Acres Medal is the gift of Mrs. Henry G. Acres in memory of her late husband, Henry G. Acres, M.E., D.Sc., a graduate of the School of Practical Science in the class of 1903. Throughout his professional life Dr. Acres was associated with major power developments in Canada and abroad. As chief hydraulic engineer for the Hydro-Electric Power Commission of Ontario in the period 1911 to 1923, he was responsible for the design and construction of nearly twenty power plants, including the Queenston-Chippawa development. Entering private practice in 1924, and until his death in 1945, he continued to widen and extend his interests. He became chief engineer of the Grand River Conservation Commission and responsible for the design and construction of the Shand dam and related work. Later, he was consulting engineer for the extensive power developments at Shipshaw on the Saguenay River, which was vital to the production of aluminum for war purposes. Many of the provinces of Canada sought his services and he advised with respect to work in Newfoundland, South America and India.

This medal is awarded annually to the student in the Fourth Year who is registered in the course in Civil, Mechanical, or Electrical Engineering, and who obtains the highest aggregate percentage at the annual examinations of the Third and Fourth Years, provided always that the student obtains honour standing in the examinations of the Fourth Year. Receipt of the medal does not preclude a student from being granted such other award as may in the opinion of the Council be appropriate.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by the late Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of the annual income from the fund is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance. When regulations do not permit the winner to hold this scholarship the students to be considered for the award shall be the first three in the year exclusive of any student who holds a scholarship of higher value.

ALCAN SCHOLARSHIP

The Aluminum Company of Canada, Limited has made available an admission scholarship of a value of $500.00 to a student entering the First Year of an Honours Course in the Faculty of Arts and Science, the Faculty of Applied Science and Engineering or in the Faculty of Law. The recipient must attain an academic standing satisfactory to the Com-

mittee of Award and demonstrate financial need. It is tenable on the later years provided First Class standing is maintained.

Application should be made to the Registrar of the University by May 1 on the regular Admission Scholarship Application form.

ALLIED CHEMICAL CANADA LIMITED SCHOLARSHIP

Allied Chemical Canada Limited has presented a scholarship of the value of tuition fees plus $250.00 to the student and a grant of $250.00 to the University, to be awarded to a student registered in the Fourth Year of the course in Chemical Engineering who has attained honour standing in the examinations of the Third Year. The recipient must be a Canadian or an American citizen and must not already be receiving other awards exceeding $250.00.

AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS SCHOLARSHIP

The Southern Ontario Chapter, American Institute of Industrial Engineers offers a scholarship of $100.00 to a student entering the Fourth Year of the Industrial Engineering course who has consistently maintained a high academic standing, but not necessarily honour standing, during the previous three years.

AMERICAN SOCIETY OF LUBRICATION ENGINEERS PRIZE

The Toronto Section of the American Society of Lubrication Engineers offers an annual prize of $75.00 to a student in the Fourth Year in Mechanical Engineering whose Thesis dealing with Lubrication is considered by the Head of the Department of Mechanical Engineering to be of suitable quality and the most satisfactory. The Prize is accompanied by a donation of $25.00 to the Department to purchase books on Lubrication.

AMERICAN SOCIETY FOR METALS FOUNDATION FOR EDUCATION AND RESEARCH SCHOLARSHIP

The American Society for Metals Foundation for Education and Research has donated $500.00 annually since 1953 to provide a Scholarship in the Faculty of Applied Science and Engineering.

The winner must:

(a) obtain the highest average percentage of marks at the examinations of the First Year in Metallurgical Engineering;

(b) register in the Second Year of the course.

This scholarship is not tenable with other awards in the gift of the Senate.

ONTARIO CHAPTER, AMERICAN SOCIETY FOR METALS BURSARY

The Ontario Chapter, American Society for Metals provides a bursary of $400.00 for a student entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than September 1. The first award was made for the Session 1958–59.

ARDAGH SCHOLARSHIP

The Ardagh Scholarship, of the annual value of the income from $5,500, has been provided in memory of his parents by Professor E. G. R. Ardagh, B.A.Sc., F.R.S.C., formerly professor of Applied Chemistry in the Faculty. It is awarded to the student who attains the highest standing in Honours at the annual examinations of the Second Year in the Course in Chemical Engineering. The first award was made on the results of the annual examination of 1946.

ATKINSON INCOURSE BURSARIES

Atkinson Incourse Bursaries, gift of the Atkinson Charitable Foundation, are awarded annually to students in the second or higher years of their courses. Applicants must have at least Second Class Honours in the final examinations of the preceding year, demonstrate financial need and be a resident of the Province of Ontario.

Applications must be submitted to the Registrar of the University on or before December 1st.

ATA TRUCKING INDUSTRY EDUCATIONAL FOUNDATION BURSARIES

The Automotive Transport Association of Ontario has established a bursary fund for students in the second or higher years of any undergraduate degree course who find themselves in serious financial need due to sudden, unexpected personal or family difficulties. Applications may be submitted to the University Registrar at any time during the session and the number and value of the bursaries will vary at the discretion of the Committee of Award.

THE BABB BURSARY FUND

Bursaries from this fund are available to students in any year of the Aeronautics Option in Engineering Physics. Application is made through the Secretary of the Faculty.

THE F. W. BALDWIN PRIZE

The F. W. Baldwin Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44), in memory of Frederick Walker "Casey" Baldwin, a graduate of the School of Practical Science, who made a significant contribution in the field of Aeronautics in Canada; and who flew, on March 12th, 1908, near Hammondsport, N.Y., the "Redwing," the first biplane built by the Aerial Experiment Association.

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in the annual examinations of Third Year in "structural subjects."

The first award was made on the results of the examinations of the Session 1953–54.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that a scholarship of one half the annual income

shall be awarded annually to an engineering student on the record of the First Year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship, up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the annual examinations of the First Year, enrolled in any one of the courses of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those courses. The first award was made on the results of the annual examinations of the Session 1925–26.

CANADIAN BECHTEL LIMITED BURSARIES

Canadian Bechtel Limited has established Bursaries in the Faculty of Applied Science and Engineering of an annual value of $1,200.00 to provide not more than four awards, each of a minimum value of $200 and a maximum value of $600. Two awards will be made to First Year students and one or two awards to students registered in any year of the Faculty. Applicants must demonstrate financial need and have academic standing satisfactory to the Faculty Council.

Application must be made to the Secretary of the Faculty on or before October 1st.

J. P. BICKELL FOUNDATION SCHOLARSHIPS

The Trustees of the J. P. Bickell Foundation have established scholarships, the number to be determined annually, in the Faculty of Applied Science and Engineering of a possible value of Fifteen Hundred Dollars, payable $500 in the First Year and provided honours are obtained at the Annual Examinations, $500 in the Second and Third Years.

An applicant must obtain an average of at least 75% at the Ontario Grade XIII examinations immediately preceding his admission to the university and must undertake to enrol in Mining Engineering, Metallurgical Engineering or Applied Geology. Failing suitable candidates in the courses mentioned students registered in the Second Year Honour course in Geological Sciences, or Physics and Geology in the Faculty of Arts and Science who are academically qualified are eligible. These awards are of the same value and are tenable in the Second, Third and Fourth Years of the course, subject to maintenance of the required academic standing. If any scholarships are not awarded to those mentioned above, students registered in the Third Year of the Engineering Science course in the Faculty of Applied Science and Engineering and taking the Physical Metallurgy or the Geophysics option who are academically qualified are eligible. In this case the scholarship will have a value of $1,000, payable $500 in each of the Third and Fourth years, provided the required academic standing is maintained.

Applications from those entering First Year must be submitted to the Registrar of the University not later than May 1st on the regular admission scholarship application form.

J. P. BICKELL FOUNDATION BURSARIES

The Trustees of the J. P. Bickell Foundation have established the J. P. Bickell Foundation Bursaries in the Faculty of Arts and the Faculty of Applied Science and Engineering. An applicant must be enrolled in Honour Science or in Mathematics, Physics and Chemistry in the Faculty of Arts, in which case he must undertake to study mining or geology in his higher years; or be enrolled in a higher year of an honour course in the geological or geophysical field in the Faculty of Arts; or be enrolled in Mining Engineering, Metallurgical Engineering, and Applied Geology in any year of the Faculty of Applied Science and Engineering. He must demonstrate financial need and have satisfactory academic standing.

Application must be made to the Registrar of the University on or before December 1st.

THE T. H. BICKLE PRIZE

The T. H. Bickle Prize is the gift of Mr. and Mrs. E. W. Bickle in memory of their son, T. H. Bickle, an undergraduate of Trinity College and a member of the Senior Intercollegiate Swimming Team at the time of his death in 1937. The income from the endowment fund will be used to purchase a suitable prize to be awarded annually to a member of the Senior Intercollegiate Swimming Team of this University in any year, faculty or school. The Committee of Award shall consist of the Dean of the Faculty of Arts, the University Registrar, the Director of Athletics, and the Honorary Coach of Swimming. In awarding the Prize the Committee shall consider the character, scholarship, and general interests of the members of the team.

J. W. BILLES ADMISSION SCHOLARSHIPS

Admission scholarships have been established from a bequest from the estate of J. W. Billes, open to students entering any degree course in the University. The value in each year is a minimum of $200.00 and a maximum of $1,500.00 dependent upon the financial need of the recipient. Applicants must satisfy the normal admission scholarship standards in their Grade XIII examinations to be eligible for an award and maintain first class honour standing to enjoy the scholarship in higher years. The number of scholarships awarded in any one year may be varied dependent upon the available funds.

Application should be made to the Registrar of the University by May 1 on the regular admission scholarship application form.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a scholarship in the Course in Mechanical Engineering of the value of One Hundred and Fifty Dollars to the student who obtains highest honour standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Chief Accountant to the fees of the Fourth Year of the successful candidate.

CALIFORNIA STANDARD COMPANY SCHOLARSHIP

The California Standard Company has presented a scholarship of $400.00 to a student who achieves outstanding results in the annual examinations of the Third Year in the Geophysics Option in Engineering Physics or in Applied Geology in the Faculty of Applied Science and Engineering or achieves the highest standing at the annual examinations of the Third Year in Physics and Geology or Geological Sciences in the Faculty of Arts and Science.

The awards alternate annually between the Faculties of Applied Science and Engineering and Arts and Science and the First award was made in the session 1960–61 in the Faculty of Applied Science and Engineering.

CARVETH METALLURGICAL LTD. BURSARY

Carveth Metallurgical Ltd. provides a Bursary of $500.00 for a student entering the Third Year of Metallurgical Engineering. The award is made primarily on the basis of Second Year standing, but the need for financial assistance will also be taken into consideration.

The Bursary is available every third year, beginning in the Session 1961–62, and is to be awarded on the recommendation of the Department of Metallurgical Engineering. Applications should be made by letter to the Secretary of the Faculty of Applied Science not later than September 1st of the year in which the award is tenable.

CHEMICAL INSTITUTE OF CANADA PRIZE

The Chemical Institute of Canada offers a prize of the annual value of $25.00 in books to the student registered in the course in Chemical Engineering who, having obtained honours, receives the highest standing in the written and laboratory work of the Third Year.

The first award was made on the results of the final examinations of 1947.

ARCHIE B. CREALOCK MEMORIAL PRIZE

The Archie B. Crealock Memorial Prize is the gift of Mrs. Archie B. Crealock, in memory of her husband, an eminent bridge engineer and a graduate of the Faculty of Applied Science and Engineering of the University of Toronto. It is offered annually to the student of the Third Year in the Course in Civil Engineering, who, having obtained honours in that year, is deemed to be the most worthy of the award. The award is made primarily on the basis of academic standing in the structural subjects of the Year, but extra-curricular activities are also taken into consideration. The Prize consists of engineering books to the value of Fifty Dollars. The award will not necessarily be made in any year.

DOMINION MAGNESIUM LIMITED BURSARY

Dominion Magnesium Limited provides a bursary of $400.00 for a student entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than 1st September. The first award was made in the Session 1958–59.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "A"

These Bursaries are available to students in financial need who are resident in Ontario, are entering the First Year of University, and have attained an average of at least 66% on eight Grade XIII papers. Application is made not later than June 15th, through the Principal of the secondary school which the student is attending.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "B"

Under this programme, Bursaries may be awarded to students in financial need who are resident in Ontario and who are in attendance at the University of Toronto. To be eligible, students must have obtained not less than sixty-six per cent. at their last annual examination. Further information may be obtained from the Secretary of the Faculty, to whom application must be made by the first week in October.

DOW CHEMICAL OF CANADA LIMITED AWARD

Dow Chemical of Canada Limited have provided funds for an annual award of $500.00 to a student in Chemical Engineering in the Faculty of Applied Science and Engineering, and a grant-in-aid of $250.00 to be used in the winner's department to help defray the cost of equipment, supplies and administration.

The winner must:

(a) be registered in the Third Year in Chemical Engineering (the award will be made in the second term of the Third Year and will be paid to the winner during his Fourth Year)

(b) be in the upper half of the class

(c) have demonstrated leadership in extra-curricular activities.

The award is not tenable with other awards in the gift of the Senate. Application is not required.

THE ELECTRICAL MANUFACTURING COMPANY LIMITED PRIZE

The Electrical Manufacturing Company Limited has established an annual Prize of $25.00 in the Faculty of Applied Science and Engineering.

The winner must:

(a) be registered in the Fourth Year in Electrical Engineering

(b) obtain the highest aggregate percentage of marks at the final examinations in the subjects of the Fourth Year related to electrical distribution equipment, the subject to be determined by the Head of the Department of Electrical Engineering.

This prize is tenable with other awards in the gift of the Senate.

THE JOHN M. EMPEY SCHOLARSHIPS

The John M. Empey Scholarship Fund was established under a bequest of $10,000 in the Will of the late John Morgan Empey, B.A.Sc., 1903. Three scholarships of equal value are provided from the income

from the Fund. One of these scholarships is awarded in each of the First, Second, and Third Years on the results of the annual examinations, to a student who, taking honours, obtains the highest average percentage of marks in the written and laboratory subjects of his Year. The scholarships are open to any students registered in the Faculty. In case the winner of any one of these scholarships does not attend this Faculty during the session next following the award, the right to the scholarship shall be forfeited and the award shall be made to another eligible student. The scholarships were awarded for the first time in 1944.

THE ENCYCLOPAEDIA BRITANNICA PRIZE

Encyclopaedia Britannica of Canada Limited presents a prize consisting of a set of books "Great Books of the Western World" to a student of the Fourth Year in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and has achieved high aggregate marks during his four years in the social-humanistic subjects common to all years.

ENGINEERING ALUMNI ADMISSION BURSARIES

The Engineering Alumni Association has made a number of bursaries with a maximum value of $600 each available annually. Applicants must be residents of Ontario, register in the First Year of the Faculty of Applied Science and Engineering, and need financial assistance.

Applicants should consult their secondary school Principal for details. Further information may be obtained from the Chairman, Engineering Alumni Education Committee, Faculty of Applied Science and Engineering, University of Toronto.

ENGINEERING ALUMNI ADMISSION SCHOLARSHIP

The Engineering Alumni Admission Scholarship, the gift of the Engineering Alumni Association, of the value of $500, is awarded to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional

knowledge among its members, offers an annual prize of Fifty Dollars in this University, commencing 1931, to the student who, in his Third Year in any one of the six courses of Engineering, has proved himself most deserving as disclosed by the examination results of the year, in combination with his activities in the Engineering Society or with a local branch of another recognized engineering organization.

ENGINEERING SOCIETY SEMI-CENTENNIAL AWARD

The Engineering Society Semi-Centennial Award, to the value of Seventy-five Dollars, was established in 1931 to commemorate the semi-centennial of the founding of the "School". The award is made to a student entering the final year.

The selection is based upon the following qualifications, which bear equal weight in the selection of the winner: (*a*) General "School" activities. (*b*) Contributions to the Engineering Society Executive Committee. (*c*) Personality, and social and athletic activities. (*d*) Academic standing.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available, each of a value of one half of the income of the fund, to students in this Course, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession, and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award shall be made to another eligible student.

HUGH GALL AWARD

The Hugh Gall Award, of the annual value of One Hundred and Forty Dollars, the gift of the Graduate Class of 1910, "to commemorate a deceased classmate who was a splendid type of student, a loyal friend, and nationally outstanding in athletic achievement during his undergraduate career", was established in 1946 for a five year period and, through the generosity of Mrs. Hugh Gall extended for a further three year period. It is awarded to a student, who, having completed his First Year with a general average of at least 66% without conditions, has entered the Second Year, and is in special need of financial assistance in order to enable him to continue his course. It is desirable, but not necessary, that the recipient shall not already have been given any other scholastic award or scholarship applicable to the Second Year and he shall have shown indications of his firm intention and ability to follow successfully the profession of engineering.

Any second year student in the Faculty of Applied Science and Engineering is eligible to apply for this Bursary. Applications should be made to the Secretary of the Faculty not later than one month after the opening of the session.

THE GRABILL ADMISSION SCHOLARSHIP

The Grabill Admission Scholarship is the gift of Mr. Dayton L. Grabill, a graduate of this Faculty in 1924. The Scholarship has a value of approximately $400.00. It is awarded to the candidate who has standing amongst those with the highest average percentages in the subjects of Ontario Grade XIII required for admission to the Faculty of Applied Science and Engineering. Applicants are required to write the Problems paper but standing in this paper is used only as auxiliary information. The candidate must write the Grade XIII examinations at one sitting in the June preceding entry to the University after not more than one year's instruction in Grade XIII and must register in the Faculty of Applied Science and Engineering.

Application should be made to the Registrar of the University on the regular Admission Scholarship form by May 1.

THE REGINALD AND GALER HAGARTY SCHOLARSHIP

The Reginald and Galer Hagarty Scholarship, in memory of the dearly beloved sons of Lieutenant-Colonel E. W. Hagarty, B.A. 1883, M.A. 1908, and Charlotte Ellen Hagarty, his wife. Reginald Edward Walter Hagarty, B.A.Sc. (Honours) 1908, a graduate of the University in the Faculty of Applied Science and Engineering and at the time of his death on April 29, 1925, a Consulting Structural Engineer. Lieutenant Daniel Galer Hagarty, Princess Patricia's Canadian Light Infantry, a member of the class of 1916 in Applied Science, enlisted for the Great War at the end of his third year in June, 1915, killed in action in Sanctuary Wood, June 2, 1916. The scholarship is given in recognition of the fact that their father was an honour graduate in Classics of the University of Toronto. It is of the value of the annual interest on the capital sum of $2000.00 and is to be awarded to a student who has been enrolled for his Grade XIII Year at Harbord Collegiate Institute and having obtained at least the required standing in each of the Grade XIII subjects necessary for admission to the Faculty, obtains the highest standing in English, a language other than English, and Mathematics, among the students who apply for the award from the Collegiate. He will be required to: (*a*) register in the Faculty of Applied Science and Engineering, (*b*) sign a declaration to the effect that he is willing to take up arms in the defence of Canada and the British Commonwealth should necessity arise as declared by the Parliament of Canada. The Scholarship was offered for award for the first time in 1945. Application should be made to the Registrar of the University.

CHESTER B. HAMILTON SCHOLARSHIP

Members of the family of the late Chester B. Hamilton, a graduate of this Faculty in 1906, have presented a Scholarship in his memory of the annual value of $500.00. It is held by a Fourth Year student in Mechanical Engineering who has achieved outstanding academic standing at the Annual Examinations of the Third Year.

The first award was made on the results of the examinations for the Session 1958–59.

HAMILTON WATCH AWARD

Hamilton Watch Company, Lancaster, Pa. presents a wrist watch, suitably engraved, to the Fourth Year student in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and who has achieved high aggregate marks during his four years in the social-humanistic subjects common to all courses.

ONTARIO CHAPTER, A.S.H.R.A.E. PRIZE

The Ontario Chapter of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers offers an annual prize of Seventy-five Dollars, first awarded in 1931, for a period of five years, and extended indefinitely in 1935. The prize will be awarded to a student in either the Third or Fourth Year in any Course of the Faculty who, in the opinion of the Department of Mechanical Engineering, has written the most satisfactory thesis on a subject dealing with heating, ventilating, air-conditioning or refrigeration, such thesis being prepared under special arrangements made by the Department of Mechanical Engineering, the result to be reported to the Council with the annual examination results. The thesis must be handed in not later than March 1. The prize will not necessarily be awarded in any year.

Application should be made to the Department of Mechanical Engineering.

THE MURRAY CALDER HENDRY SCHOLARSHIP

This award was established by the estate of Mrs. Grace Appel Hendry as a memorial to her husband, a graduate of this Faculty in 1905. It has a value of the income from a capital sum of $10,000 and the recipient must:

(a) have attained an average of at least 75% on nine grade XIII examination papers, written at one sitting, required for admission to the Faculty and have the highest marks in the Problems paper;

(b) be entering the First Year of any course in the Faculty of Applied Science and Engineering.

Application must be made to the Registrar of the University by May 1 on the regular University Admission Scholarship Application form.

The first award will be made for the session 1962–63.

HUDSON BAY MINING AND SMELTING COMPANY LIMITED SCHOLARSHIPS

The Hudson Bay Mining and Smelting Company Limited awards Scholarships to students who have obtained their Senior Matriculation at the High Schools in Flin Flon, Manitoba, and its environs. These Scholarships, having a value of $800.00 each annually, may be held in the Third and Fourth Years in this Faculty, in the Course in Chemical Engineering, Metallurgical Engineering, Mining Engineering, and Applied Geology. Application should be made to the Company.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO SCHOLARSHIPS IN ENGINEERING

The Hydro-Electric Power Commission of Ontario has presented three scholarships in Engineering, each of a value of $300.00 to be awarded to three students selected from among the higher ranking students in the annual examinations of the First, Second, and Third Years in any course in the Faculty, one scholarship in each year to be tenable in the Second, Third and Fourth Years respectively.

The first award was made at the annual examinations in April, 1952.

IBM—THOMAS J. WATSON MEMORIAL BURSARY FUND

International Business Machines Company Limited has made available one or more bursaries of a total annual value of $1,000.00 to students registered in any year of a full time course in the university who have standing satisfactory to the Committee of Award and demonstrate financial need.

Application should be made to the Registrar of the University by October 31.

THE INCO SCHOLARSHIP

The International Nickel Co. of Canada Limited has established a Scholarship for students entering the University. Each Scholarship provides for tuition fees plus $300.00 and may be continued throughout a four-year course if satisfactory standing is maintained.

To be eligible for consideration the applicant must obtain an average of 75% or over in the Ontario Grade XIII subjects required for admission to his course and demonstrate financial need.

Application must be made to the Registrar of the University by May 1st on the regular scholarship application form.

JENKINS SCHOLARSHIP

The Jenkins Scholarship, presented by Jenkins Bros., Limited, Montreal, first awarded in 1925, has been donated to continue indefinitely.

This Annual Scholarship, of the value of Two Hundred Dollars, is awarded to the student of the Third Year registered in any course of the Faculty who has the highest aggregate of percentages for the First, Second, and Third Years.

JOHNSON'S WAX SCHOLARSHIP

S. C. Johnson and Son Limited, Brantford, Ontario, have established a Scholarship of an annual value of $600 in each of the Second, Third and Fourth Years or a total possible value of $1800.

The recipient must:

(*a*) be registered in Chemical Engineering in the years in which the Scholarship is awarded and held;

(*b*) in the opinion of the Council be the most promising and deserving member of the class, obtaining Honours in the final examinations of the First Year;

(*c*) in his Second and Third Years, maintain academic standing satisfactory to the Council, not necessarily Honours, for the continued enjoyment of the Scholarship.

In its discretion the Council may recommend the award of any portion of the Scholarship, lost by the original recipient by failure to maintain satisfactory academic standing, to another student of the year(s) in which the Scholarship would otherwise have been enjoyed.

The first award was made on the results of the annual examinations written in April 1954. It is not tenable with any other Scholarship.

KENNECOTT COPPER AWARD IN INDUSTRIAL ENGINEERING

Kennecott Copper Corporation offers an Annual Award in Industrial Engineering of the value of $1,000.00. The recipient of the Award must:

(a) be registered in the Second, Third or Fourth year of the course in Industrial Engineering;

(b) have attained Honours in the final examinations of the previous year;

(c) show qualities of leadership and initiative.

The financial need of the student may be taken into consideration.

Application should be made to the Secretary of the Faculty by October 30.

KIMBERLY-CLARK CORPORATION OF CANADA LIMITED SCHOLARSHIPS

Kimberly-Clark Corporation of Canada Limited has presented two scholarships of a value of $500.00 each and each scholarship is accompanied by a grant of $100.00 to the general funds of the University. The Scholarships are awarded on the annual examinations of the First and Second Years and one scholarship is awarded to an outstanding student of the First Year and one to an outstanding student of the Second Year as indicated by the examination results of their respective years. Students in all courses of the First and Second Years are eligible.

The First awards were made on the results of the annual examinations for 1957–58.

THE LEVER BROTHERS SCHOLARSHIPS

Lever Brothers Limited have established two Scholarships of $300.00 each in the Department of Chemical Engineering. The Scholarships will be awarded to a student of the Second Year and to a student of the Third Year in Chemical Engineering to be held in the Third and Fourth Years respectively. The award is based on outstanding scholarship at the annual examinations.

The first awards were based on the annual examinations of 1957.

THE LEONARD FOUNDATION SCHOLARSHIPS

Leonard Foundation Scholarships are awarded each year to selected students in Universities and Colleges across Canada, including the University of Toronto. The Trust Deed states: "Preference in the selection of students for scholarships shall be given to the sons and daughters respectively of the following: (*a*) clergymen, (*b*) school teachers,

(*c*) officers, non-commissioned officers and men, whether active or retired, who have served in His Majesty's military, naval or air forces, (*d*) graduates of the Royal Military College of Canada, (*e*) members of the Engineering Institute of Canada, (*f*) members of the Mining and Metallurgical Institute of Canada."

All applicants must be nominated by a member of the General Committee. The latest date for the receiving of applications is March 31st, for the following academic year. Further information regarding the procedure to be followed in applying for these scholarships may be obtained by writing to Dr. W. E. Taylor, Honorary Secretary, The Leonard Foundation, c/o Toronto General Trusts Corporation, 253 Bay Street, Toronto.

THE J. EDGAR MCALLISTER FOUNDATION

Through the generosity of the late J. Edgar McAllister, a graduate of the Faculty in 1891, a fund has been established in the university to be known as the J. Edgar McAllister Foundation, to provide financial aid for students who require it, in Mining, Mechanical, Chemical, Electrical and Metallurgical Engineering. Inquiries should be made in the Faculty Office.

THE JOHN WOLFE MCCOLL MEMORIAL AWARDS

These six awards, two of which are open to students in the Faculty of Applied Science and Engineering, are the gift of the estate of the late John Wolfe McColl. The awards have a minimum value of $250.00 and a maximum of $750.00. Applicants must have obtained First Class Honours at the final examinations of the preceding year, whether Ontario Grade XIII or at the University of Toronto, demonstrate financial need and be enrolled or undertake to enrol in either Engineering Physics or Chemical Engineering. Students seeking first admission to the University must submit applications for an award to the Registrar of the University on or before May 1st. Students in the University must submit applications for an award to the Registrar of the University on or before October 15th.

THE J. A. D. MCCURDY PRIZE

The J. A. D. McCurdy Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44) in honour of John Alexander Douglas McCurdy, a graduate of the School of Practical Science, who "made the first flight in Canada on February 23rd, 1909, with a heavier-than-air machine."

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in annual examinations of the Third Year in the subjects related to Aerodynamics.

The first award was made on the results of the examinations of the Session 1953–54.

THE GARNET W. MCKEE-LACHLAN GILCHRIST SCHOLARSHIP IN ENGINEERING PHYSICS

Mrs. Garnet W. McKee and Professor Lachlan Gilchrist each contributed $1000.00 to provide for a Scholarship in the First Year of the Course in Engineering Physics. The value of the Scholarship is the annual income from the capital fund and is awarded to the student who ranks first in honours at the annual examinations of the First Year in the Course in Engineering Physics. If for any reason that student is ineligible to hold the Scholarship, it will be awarded by reversion to the student ranking second in honours in the Course. In order to receive payment the winner must register in the Second Year of the Course in Engineering Physics. The Scholarship was awarded for the first time on the results of the annual examinations of 1947.

THE GARNET W. MCKEE-LACHLAN GILCHRIST GEOPHYSICS SCHOLARSHIPS

Financial assistance was received by Professor Lachlan Gilchrist of the Department of Physics, University of Toronto, from certain organizations and individuals to help him in the prosecution of his research work in Geophysics. With the consent of the contributors, the unexpended balance of these gifts was transferred by Professor Gilchrist to the Board of Governors of the University to be used as an endowment for scholarships, two of which were established in the Faculty of Applied Science and Engineering. To this fund have been added additional amounts received from the estate of the late Garnet W. McKee and from the Hollinger Consolidated Gold Mines Ltd. They are awarded by the Senate, on the recommendation of the Council of the Faculty of Applied Science and Engineering. The first awards were made on the results of the Annual Examinations of 1941.

The First Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $4,000.00, is awarded to the student in the Second Year in the Course of Engineering Physics who obtains the highest aggregate standing at the examinations of the First and Second Years in the Course, provided always that the student obtains honour standing at the examinations of the Second Year.

The Second Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $3,000.00 is awarded to the student in the Second Year in the Course of Engineering Physics who, of those students who elect to proceed in the Third Year in the Geophysics Option of the Course, obtains the highest aggregate standing at the examinations of the First and Second Years, provided always that the student obtains honour standing at the examinations of the Second Year, and excluding always the student to whom the First Lachlan Gilchrist Geophysics Scholarship has been awarded.

If in any year there is no student who has fulfilled the conditions as laid down for the Second Lachlan Gilchrist Geophysics Scholarship, it shall be awarded to the student in the Second Year in the Course in Engineering Physics who obtains the second highest aggregate standing

at the examinations of the First and Second Years of that Course, provided always that such student obtains honour standing in the examinations of the Second Year.

THE ALEXANDER MACLEAN SCHOLARSHIP

This scholarship was established by graduates of the University of Toronto and other friends in honour of Professor Alexander MacLean, B.A. (1908) who retired in 1954. The scholarship, of the value of $250, is awarded to a student in the Third Year of Geological Sciences, Faculty of Arts, or in the Third Year of Applied Geology, Faculty of Applied Science and Engineering, who, obtaining not less than 75% in the work of the year, obtains the highest standing in the geological subjects common to the two courses.

The first award was made in 1955.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. If in any year no award is made, a second award will be available in a subsequent year.

CHARLES GORDON MANNING PRIZE

The Charles Gordon Manning Prize was established by a bequest under the Will of the late Jennie Manning in the amount of Five Hundred Dollars ($500), the annual income from which is to be used to buy books for the winner of the Prize.

The recipient must be enrolled in the Second Year of a course offered by the Faculty of Applied Science and Engineering and, in the opinion of the Council, rank second to the student awarded the Harvey Aggett Memorial Scholarship in the considerations specified for the award of that Scholarship, namely, obtaining honours in his final examinations and being one of the first three in his year by his standing at those examinations relative to the pass requirements in his Department and being "adjudged highest of the three in general student activities and service in the University during his period of attendance."

The first award was made on the results of the Annual Examinations of 1954.

MARSLAND ENGINEERING LIMITED SCHOLARSHIP

The Marsland Engineering Limited Scholarship, the gift of Marsland Engineering Limited, has a value of Two Hundred and Fifty Dollars. It is awarded to the student who, having been granted a Dominion-Provincial Student Aid Bursary in his First Year, is registered in Mechanical or Electrical Engineering and obtains the highest average percentage of marks, with honours, at the annual examination of the First, Second or Third Years in the session in which the award is made.

The first award was made at the annual examinations of 1954.

MASSEY-FERGUSON LIMITED SCHOLARSHIPS

Massey-Ferguson Limited has established two scholarships each of an annual value of $250.00, to be awarded on the recommendation of the Council of the Faculty of Applied Science and Engineering to students registered in the Fourth Year of the Courses in Mechanical Engineering or Industrial Engineering. In making the award academic achievement, financial need, extra-curricular activities and such other factors as may be deemed appropriate will be taken into consideration.

Application should be made to the Secretary of the Faculty not later than 15th October.

THE W. G. MILLAR MEMORIAL SCHOLARSHIP

The W. G. Millar Memorial Scholarship is presented by Marsh and McLennan, Limited, of an annual value of $250.00, in memory of the late Mr. W. G. Millar, a member of the Class of 1914 in Civil Engineering. The Scholarship will be awarded to a student entering the Third Year in Mining Engineering, on the recommendation of the Head of the Department of Mining Engineering.

The award will be made on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

MOBIL OIL OF CANADA, LIMITED, SCHOLARSHIP

Mobil Oil of Canada Limited has donated a scholarship of the annual value of $400.00, tenable in the graduating year of either Geological Sciences, Faculty of Arts or Applied Geology, Faculty of Applied Science and Engineering. The award is based on academic performance in the first three years. Good character, personality, breadth of influence, initiative, willingness to assume responsibility and ability to co-operate with associates may be taken into consideration.

Application is not required.

JAMES L. MORRIS MEMORIAL PRIZE

The James L. Morris Memorial Prize is the gift of Mrs. J. H. Craig and Mr. J. R. Morris, K.C., in memory of their father, James L. Morris, C.E., O.L.S., D.Eng., the first graduate of the School of Practical Science, who died in 1946 after a distinguished career. Graduating in Civil Engineering in 1881 as the sole member of his class, Dr. Morris engaged in railway work for some time, first as an engineer and then as a contractor. For 43 years he conducted a successful civil engineering practice in Pembroke, Ontario, involving important undertakings in the field of municipal, power and bridge work.

This Prize, of the value of the annual income from $3,000.00, is awarded annually to the student in the Second Year in the Course in Civil Engineering who obtains the highest aggregate percentage at the annual examinations of the First and Second Years of the course, provided always that the student obtains honour standing at the Examinations of the Second Year.

SPRUCE FALLS POWER AND PAPER COMPANY LIMITED SCHOLARSHIPS

The Spruce Falls Power and Paper Company Limited has established four Scholarships of a value of $400.00 each, two in the Second Year and two in the Third Year. They are awarded on the results of the Annual Examinations of the Second and Third Years to the students who obtain honour standing at the examinations of their respective years and are open to students in all courses in the Faculty. The first awards were made on the results of the examinations of 1951.

Each scholarship carries a grant of $150 to the University General Funds.

NORTHERN ELECTRIC UNDERGRADUATE SCHOLARSHIP

The Northern Electric Company Limited have established a Scholarship in the Faculty of Applied Science and Engineering and the Faculty of Arts of an annual value of $500.00. In this Faculty the scholar must be registered in the Second or Third Year of Electrical Engineering, Mechanical Engineering, Engineering Physics or Engineering and Business. He must also (a) be a Canadian citizen or landed immigrant and (b) have a minimum of 75% or its equivalent in the previous annual examinations, in this or another recognized University.

The award is made alternately in the two faculties, the first in the Faculty of Arts in 1959 and in the Faculty of Applied Science and Engineering in 1960 and in a similar manner thereafter. Application is not required.

THE ONTARIO HOCKEY ASSOCIATION WAR MEMORIAL SCHOLARSHIP

The Ontario Hockey Association War Memorial Scholarship, the gift of the Ontario Hockey Association, is to be awarded annually at the Grade XIII examination to a man student who has served overseas with the Canadian forces, or to a student who is the son or daughter of one who has so served.

The value of this scholarship is $100 in cash, with an allowance of the same amount on the tuition fee for each session.

In determining the award of the scholarship, the academic qualifications of the candidate shall be first taken into account, provided always that no candidate shall be eligible for an award who has not met all the conditions required by the University of candidates for admission scholarships generally; but, *cæteris paribus*, the award shall be made to a student who is in proved need of assistance.

The award shall be made by the Senate of the University upon the report of a committee to be appointed by the Senate, upon which committee there shall be always one member of the Staff of the University who shall be deemed to be the representative of the Association.

Candidate shall make application not later than May 1st on the special form to be obtained from the Registrar of the University.

ONTARIO MUNICIPAL ELECTRIC ASSOCIATION BURSARY

District No. 4 of the Ontario Municipal Electric Association has provided a Bursary of $300.00 in the Faculty of Applied Science and Engineering.

An applicant for the Bursary must:

(a) be registered in the Fourth Year, Electrical Engineering
(b) have good academic standing
(c) be in need of financial assistance

Application should be made to the Secretary of the Faculty not later than October 15th.

ORENDA ENGINES SCHOLARSHIPS

Orenda Engines Limited have donated three scholarships each of a value of Five Hundred Dollars, awarded annually to students completing the First, Second and Third Years respectively in courses other than Mining Engineering and Applied Geology. These scholarships are awarded to students with high academic standing and in cases of close competition, preference will be given to the student who indicates that he possesses initiative and leadership qualities and that he will be a credit to his profession after graduation.

This award may be held with other awards provided that the monetary value of the other awards does not exceed One Hundred Dollars. The first award was made in the Session 1955–56.

PAULIN MEMORIAL SCHOLARSHIP

The Paulin Memorial Scholarship, provided through the generosity of the late Mr. Fred W. Paulin, a graduate of the Faculty in 1907, was established in memory of his brother, John Cameron Paulin, a student in Mining Engineering, who was fatally injured in 1906 during a football practice. The Scholarship which has a value of annual income from capital fund of $10,000.00, approx. $400.00, is awarded on the recommendation of the Department of Mining Engineering to a student registered in Mining Engineering, who has successfully completed the work of the First Year.

The award is made on the following bases:

(*a*) academic proficiency.

(*b*) qualities necessary for the development of leadership, such as ambition, initiative, resourcefulness and strength of character.

(*c*) he must continue his studies in Mining Engineering during the following session.

The first award was made for the Session 1951–52.

PROCTER AND GAMBLE BURSARY PLAN

Procter and Gamble Bursaries, the gift of the Procter and Gamble Company of Canada, are awarded annually to students in all years. Applicants must have at least Second Class Honours or better in the final examinations of the preceding year and demonstrate financial need. Applications must be submitted to the Registrar of the University on or before December 1st.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO ADMISSION SCHOLARSHIP

The Association of Professional Engineers of the Province of Ontario has established an Admission Scholarship in Engineering of the value of $500.00. It is awarded to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its euivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Application must be made to the Registrar before May 1.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO SCHOLARSHIPS

The Association of Professional Engineers of the Province of Ontario offers Scholarships of a value of $250.00 in each of the First, Second and Third Years in the Faculty of Applied Science and Engineering in any course, to the students who, taking Honours, obtain the highest standing in the work of their respective years.

These scholarships will not be awarded to students who hold other scholarships.

PROFESSIONAL ENGINEERS GOLD MEDAL

The Association of Professional Engineers of the Province of Ontario has established in the Faculty of Applied Science and Engineering an

award in the form of a gold medal accompanied by a gift of technical books of an approximate value of fifty dollars. The award will be made to the student of the final undergraduate year in any course who, taking honours, obtains the highest weighted average percentage in the practical work and written examinations of the year.

RANSOM SCHOLARSHIP IN CHEMICAL ENGINEERING

The Ransom Scholarship in Chemical Engineering is presented by A. C. Ransom, Esq., of Toronto, for the purpose of encouraging and giving financial assistance to students who choose the field of Chemical Engineering. This donation, consisting of $5,000, provides for a perpetual scholarship of an annual amount such as will be derived from the income of this sum. The first award was made on the results of the annual examinations of 1938.

The scholarship will be awarded annually to the student registered in the Course in Chemical Engineering who obtains the highest aggregate percentage of marks in the examinations of the First Year. The scholarship will be paid to the winner only if he proceeds to take his Second Year in the Course in Chemical Engineering in the University of Toronto.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer for award in the Province of Ontario two out of ten of the Rhodes Scholarships for Canadians, each of the basic value of £400 a year but temporarily increased to £750. They are tenable ordinarily for two years at the University of Oxford. A third year given conditionally at Oxford or elsewhere abroad may be authorized in proper cases.

Each candidate must be a British subject with at least five years domicile in Canada and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year *for* which he is elected; he must have completed the first year and have entered upon the second year of his course at a Canadian university at the time of application.

A candidate may apply either for the province in which he has his private home or residence, or for the province in which he has taken his university course.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;
(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;
(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;
(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Some definite quality of distinction, whether in intellect, character or personality, or in any combination of these, is the most important requirement. Financial need does not receive special consideration.

Forms of application and full information regarding these scholarships may be obtained from D. R. Michener, Esq., Q.C., 5 Rosedale Road, Toronto 5, General Secretary for the Rhodes Scholarships in Canada or from A. B. Harvey, Esq., Q.C., c/o Law Society of Upper Canada, Osgoode Hall, secretary of the Ontario Selection Committee, or from the University Registrar. Selection is made in December each year for the scholarships for the year following. Application must be made to Mr. Harvey or the appropriate provincial secretary on or before November 1st.

R.C.E. MEMORIAL SCHOLARSHIP

The Memorial Fund Committee of the Royal Canadian Engineers has established the R.C.E. Memorial Scholarship of a value of One Hundred and Twenty-five Dollars, open to students who have successfully completed their second to last year in the Faculty of Applied Science and Engineering or the School of Architecture.

A candidate must be

(a) a member in good standing of the Canadian Officers Training Corps and have successfully completed one summer season's training

or

(b) an ex-member of the Canadian Officers Training Corps who has successfully completed his three years of C.O.T.C. training

or

(c) a member of the Canadian Army (Regular) attending University under the Regular Officers Training Plan.

Selection is made on the basis of academic standing and of qualities of leadership.

Application forms may be obtained at the C.O.T.C. Orderly Room, 119 St. George St.

HELEN E. ROGERS ADMISSION SCHOLARSHIPS

Admission scholarships have been established from a bequest from the estate of Helen E. Rogers open to students entering any degree course in the University. Preference is given to applicants from outside Ontario but failing such candidates awards may be made to qualified Ontario students. Recipients must have a standing satisfactory to the Committee of Award on first admission and may continue to enjoy the scholarship in the upper years provided they maintain first class standing. The value in each year is a minimum of $200.00 and a maximum of $1,500.00 dependent on financial need. The number of awards made each year is determined by the annual income available.

Application should be made to the Registrar of the University by May 1 on the regular admission scholarship application form.

FREDERICK W. SCHUMACHER SCHOLARSHIP

The Frederick W. Schumacher Scholarship has been established in the Faculty of Applied Science and Engineering and in the Faculty of Arts under a bequest of the late Frederick W. Schumacher. It has a value of the income from the fund. The scholar must (a) be enrolled in

the Second, Third or Fourth years in Mining Engineering or Applied Geology in the Faculty of Applied Science and Engineering or in Physics and Geology or Geological Sciences in the Faculty of Arts and (b) must have high academic standing.

Applications must be submitted to the University Registrar not later than October 15th.

THE SCOTTISH RITE MASONS' BURSARY

The Scottish Rite Masons' Bursary, the gift of the Scottish Rite Masons of Toronto, of the value of $400.00 is awarded to a student enrolled in the Second Year who is a member of the Masonic Order, or a son, brother, nephew, daughter, sister or niece of a member of the Masonic Order. Consideration will be given to financial need and academic standing. Evidence of connection with the Masonic Order and information regarding financial need must be given with the application which must be submitted to the Secretary of the Faculty on or before October 15th.

"SECOND MILE ENGINEER" AWARD

Inspired by an address of President William E. Wickenden of Case School of Applied Science, Cleveland, called "The Second Mile", which was based on the text from the Sermon on the Mount, "whosoever shall compel thee to go one mile, go with him twain", the Class of 1935 has established the "Second Mile Engineer" Award. It is the desire of the donors to encourage students to participate in activities outside the confines of their technical training and to interest themselves in the more liberal subjects of the curriculum. The value of the award is $100.00 and is given to a student in his final year.

An eligible group is chosen from those who have taken a prominent part in the affairs of the Faculty, either as office holders or in athletics. In making the award consideration is given to academic standing, with special emphasis on the candidate's attainments in the cultural and humanistic-social studies. The subjects which are stressed are English and Political Science of the First Year; Economics of the Second Year; and Modern World History of the Third Year.

Particulars are furnished each session by the Class of 1935.

THE SIMPSON-SEARS LIMITED (NORTHERN ONTARIO) SCHOLARSHIPS

These scholarships, the gift of Simpson-Sears Limited, are open only to students of the Copper Cliff High School, The Sudbury High and Technical Schools, the Sturgeon Falls High School, the North Bay Collegiate Institute and Vocational School, the Kapuskasing High School and all the Secondary Schools along the Ontario Northland Railway. A scholarship of the value of $100 is available for each of the schools mentioned and an additional sum of $50 will be given to the student who obtains the highest percentage of the nine papers of Grade XIII selected in accordance with the regulations.

No scholarship will be awarded unless the candidate is in actual attendance in one of the colleges or faculties of the University and maintains a uniformly high standard to the satisfaction of the donors of the scholarships.

Application for these scholarships must be sent not later than May 15th, to the Principal of the North Bay Collegiate Institute and Vocational School, from whom further information may be obtained regarding conditions of award.

SMITH AND STONE LIMITED BURSARIES

Smith and Stone Limited, Georgetown, Ontario, have provided five Bursaries, each of a possible value of $600 and each payable at the rate of $150 per year to assist deserving students from the Georgetown High School.

The award is made annually by the Senate on the recommendation of the Council of the Faculty to a student:

(*a*) who attended Georgetown High School for at least 2 years and is recommended by the Principal;

(*b*) who has met in full the admission requirements of the Faculty, first class honours not being a requirement.

To be eligible for continued enjoyment of the Bursary the holder must maintain satisfactory academic standing but not required to obtain honour standing.

The award was offered for the first time in the Session 1952–53.

SOCIETY OF CHEMICAL INDUSTRY MERIT AWARD

The Society of Chemical Industry Merit Award is made annually by the Society to the student in Fourth Year in the Department of Chemical Engineering who obtains the highest weighted average of marks in the results of the annual examinations for the year. The award is a gold key.

THE WILLIAM STORRIE MEMORIAL SCHOLARSHIPS IN CIVIL ENGINEERING

Three Scholarships have been established by Mrs. William Storrie in memory of her husband, the late William Storrie, a Consulting Engineer on many municipal projects in Canada and for several years a special lecturer in the Faculty of Applied Science and Engineering, for students in Civil Engineering, as follows:

(a) Of a value of $100.00 to the student completing his Second Year in Civil Engineering with the highest aggregate standing in the subjects of Calculus, Engineering Chemistry, Mechanics of Materials, and Surveying.

(b) Of a value of $100.00 to the student completing his Third Year in Civil Engineering with the highest aggregate standing in the subjects of Cements and Concrete, Structural Engineering, Engineering Problems and Drawing, and Hydraulics.

(c) Of a value of $200.00 to the student completing his Fourth Year in Civil Engineering with the highest aggregate standing in the subjects of Hydraulics, Municipal Administration and Contracts, Sanitary Engineering, and Thesis and Public Speaking.

In all cases the candidates shall have demonstrated qualities of integrity and shown promise of leadership in their profession.

The first awards were made for the Session 1956–57.

STUDENTS' ADMINISTRATIVE COUNCIL ADMISSION SCHOLARSHIP

The Students' Administrative Council Admission Scholarship of the annual value of $300, the gift to a student who (*a*) resides within the District of Manitoulin, or within that part of the Province of Ontario which lies north of the forty-sixth parallel of latitude excluding the cities of North Bay, Sudbury, Sault Ste. Marie, Port Arthur and Fort William; (*b*) obtains the highest average standing in first class honours in the nine papers of Grade XIII prescribed for admission to the course which he desires to enter: and (*c*) who enrols in one of the following faculties: Medicine, Applied Science and Engineering, Forestry, Dentistry, in the School of Architecture, or in the Four-Year Course leading to the degree of Bachelor of Science in Pharmacy.

The scholarship is tenable for two years provided that the holder obtains an average of at least sixty-six per cent. at the annual examinations of the First Year. Application must be made to the University Registrar not later than May 1st.

THE TRANE COMPANY OF CANADA LIMITED PRIZE

The Trane Company of Canada Limited has established an annual Prize of $200.00 in the Faculty of Applied Science and Engineering. The recipient may be registered in the Fourth Year in any course and the Prize will be awarded for the best Thesis on air-conditioning or refrigeration, either for comfort cooling or industrial use.

This award is tenable with other awards in the gift of the Senate. Application is not required.

EDITH TYRRELL MEMORIAL BURSARY

The Women's Association of the Mining Industry of Canada has presented this Bursary, having the value of Five Hundred Dollars, annually, commencing in 1939, and named in memory of their founder and first president, Mrs. Edith Tyrrell. A medal donated by Dr. Tyrrell accompanies the Bursary. The Bursary is awarded to a student entering the Third or Fourth Year in the Course in Mining Engineering, Metallurgical Engineering, or Applied Geology; it may be awarded two years in succession to the same student, but will usually be awarded at the beginning of the Third Year. The award will be made by a special committee appointed by the Association on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

S. UBUKATA FUND

The S. Ubukata Fund for Japanese Students, the gift of the late S. Ubukata, provides for the establishment of scholarships, bursaries, medals,

prizes, and loans for students from Japan proper attending the University of Toronto or one of its federated or affiliated colleges. An applicant for a scholarship, bursary or loan must be in good standing and have completed the first year of the work of the faculty or department in which he is registered. An occasional student must obtain a certificate from the head of the college or dean of the faculty concerned that full time is being devoted to his or her studies. A student is not eligible who is at the time in receipt of aid or support from any other institution, religious or otherwise, in this country or in Japan or who already holds a scholarship or fellowship in the University. Application must be made to the University Registrar on or before December 1st.

UNIVERSITY OF TORONTO ALUMNI ASSOCIATION WAR MEMORIAL SCHOLARSHIPS OR AWARDS

Six scholarships and awards, each of the value of $200.00 will be granted in 1960–61 by the Alumni Association from the War Memorial Scholarship Fund to students registered in the Faculty of Applied Science and Engineering.

The general basis on which scholarships or awards may be granted will be as follows: (*a*) standing in course of studies; (*b*) relationship to active service in the armed forces of Canada; (*c*) need of financial assistance; (*d*) merit shown by participation and interest in extra-curricular undergraduate activities of the University; (*e*) such other qualifications as may commend themselves to the Alumni Association.

Information regarding these scholarships and awards may be obtained from The University of Toronto Alumni Association, 18 Willcocks Street, to whom application must be made before March 1st.

UNIVERSITY NAVAL TRAINING DIVISION BURSARIES

The University Naval Training Division Bursaries, the gift of the University Naval Training Division, are of the value of $100 each. As many as three bursaries may be awarded in each session; if fewer than three are awarded those not awarded may be given in a subsequent session. A candidate must be registered in the University for a full-time course leading to a diploma or degree and must be at the time of the award a member of one of the recognized military training units within the University. Application must be made to the University Registrar before the end of November.

UNIVERSITY OF TORONTO GENERAL BURSARIES

The Board of Governors has established a fund to provide bursaries for deserving students who without financial assistance cannot continue their formal education. Further information may be obtained from the Secretary of the Faculty.

THE U.T.S. ENGINEERING SCHOLARSHIP

The U.T.S. Engineering Scholarship, the gift of R. A. Bryce, Esq., of the value of $250. The scholarship will be awarded by a committee of the Staff of the University of Toronto Schools to a student of the Schools who has completed the requirements for admission to and enrols in the Faculty of Applied Science and Engineering.

WALLBERG ADMISSION SCHOLARSHIPS

Two admission scholarships, each of a value of $500.00 are awarded annually from the income from the Wallberg Bequest on the recommendation of the Council of the Faculty to the two candidates who obtain the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that this attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Applications must be submitted to the Registrar on the prescribed form by May 1st.

WALLBERG UNDERGRADUATE SCHOLARSHIPS

These scholarships, four in number, of the value of $500.00 each, derived from the Wallberg Bequest, are awarded annually; two to students ranking first and second respectively at the annual examinations of the First Year; one to the student ranking first at the annual examinations of the Second Year; and one to the student ranking first at the annual examinations of the Third Year.

Any holder of one of these scholarships may not hold other awards listed in the Calendar with an asterisk. The awards were first made on the result of the annual examination of 1947.

WILLIAM R. WORTHINGTON MEMORIAL SCHOLARSHIP

The William R. Worthington Memorial Scholarship, the gift of Miss Ida R. Worthington, in memory of her brother, William R. Worthington, Dip.(1904), B.A.Sc.(1905), of the value of the income from a fund is awarded annually to the student of the Second Year in the course in Civil Enginering who ranks highest at the anual examinations of that year.

The first award was made at the examinations for the Session 1954–55.

ALUMINIUM LABORATORIES LIMITED FELLOWSHIP

The Aluminium Laboratories Ltd. have established a fellowship valued at $1100 or $1800 (8- or 11-month tenure) plus fees. This award will be held in the School of Graduate Studies by a candidate for a Master's or a Doctor's degree in the fields of mathematic or physical sciences, pure or applied, preference being given to students in the field of physical metallurgy.

THE ATHLONE FELLOWSHIPS

Her Majesty's Government in the United Kingdom has established a number of fellowships to be awarded annually to enable Canadian engineering graduates to take postgraduate training in the United Kingdom. These became available in 1951 when five fellowships were open to graduates of the University of Toronto immediately after graduation. Additional fellowships are for award to graduates who have already spent some time in industry. The fellowships cover costs of transport, fees and maintenance and are normally tenable for a period of two years. They may be utilized for (*a*) works training in industry, (*b*) postgraduate university study, or (*c*) a combination of these. Candidates must be Canadian citizens or British subjects normally resident in Canada and should preferably be less than 27 years of age. Further information and application forms may be obtained from the Secretary of the Faculty.

THE C.I.L. FELLOWSHIPS

Two Fellowships, the gift of Canadian Industries (1954) Limited, of the value of $2,000 each are established for the encouragement of post-graduate work in Chemistry. An applicant must be a university graduate who is a Canadian citizen or a graduate who intends to follow a career in Canada, with preference to Canadian citizens. The holders of these Fellowships will be required to undertake research in any branch of Chemistry under the direction of the department designated by the Committee of Award. Application must be made, with full statement of qualifications and testimonials, to the Secretary of the School of Graduate Studies not later than March 1st.

CANADIAN LUMBERMEN'S ASSOCIATION TIMBER RESEARCH FELLOWSHIP

This fellowship, donated by the Canadian Lumbermen's Association, is offered to encourage advanced study and research in timber engineering. It is open to graduates in engineering and graduates in forestry of any recognized university. The fellow must be registered in the School of Graduate Studies as a student proceeding to a post-graduate degree and must carry out a prescribed programme of study and research in both engineering and forestry. It is intended that the work of this programme will extend over a period of two academic years. The annual value of the fellowship is $1,250, all of which might not be granted to one student.

Application should be made to the Secretary of the School of Graduate Studies not later than September 1st and should be accompanied by an official transcript of the applicant's undergraduate record, together with a statement of his experience in the forestry and construction fields.

COMMONWEALTH SCHOLARSHIPS

Under a Plan drawn up at a conference held in Oxford in 1959, each participating country of the Commonwealth offers a number of scholarships to students of other Commonwealth countries. These scholarships

are mainly for graduate study and are tenable in the country making the offer. Awards are normally for two years and cover travelling, tuition fees, other university fees, and a living allowance.

For details of the awards offered by the various countries consult the Registrar's Office, or write to The Canadian Universities Foundation, 77 Metcalfe Street, Ottawa.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIPS

The Royal Commissioners for the Exhibition of 1851 have invited the University of Toronto to recommend annually one or more candidates in order of merit for science research scholarships, each of the value of £350 per annum and ordinarily tenable for two years. The Commissioners may make a supplementary grant up to £50 per annum for University fees, etc., payable by the scholar during his tenure of the award.

Each candidate recommended must be a British subject, and under twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University, the students of which are eligible to apply for these scholarships: 1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geological Sciences; 13. Physics; 14. Physiology; 15. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the university, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board is appointed by the Senate and has power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than March 1st to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

IMPERIAL OIL GRADUATE RESEARCH FELLOWSHIPS

Imperial Oil Limited in 1946 established for annual competition Graduate Research Fellowships, now five in number and having a potential value of $4,800 each ($1,600 a year for a maximum of three years). Each fellowship may be supplemented by an annual amount of $900 if the fellow continues his thesis work during the summer months. A fellow may not hold concurrently other awards which annually equal or exceed the value of the regular Imperial Oil payments ($1,600).

The fellowships are open to any graduate of any approved Canadian university and are offered for research leading to a Doctor's degree in the fields of Chemistry, Physics and/or Engineering (2 fellowships), Geology (1 fellowship), Economics, Psychology, Sociology, or Business Administration (1 fellowship) and Humanities such as English, Ancient and Modern Languages, History, or Philosophy (1 fellowship). Nomination of students for the fellowships is made by the university—such nominations to be received by the Secretary, Imperial Oil Scholarship Committee, Imperial Oil Limited, 111 St. Clair Avenue West, Toronto 7, not later than March 1st of each year.

THE INTERNATIONAL NICKEL GRADUATE RESEARCH FELLOWSHIPS

The International Nickel Company of Canada has established a number of Graduate Research Fellowships, to promote and encourage research in the technical fields serving the Canadian metal industries and to further public interest in industrial science in Canada. Each has a possible tenure of three years with an annual payment of $2,500, of which $2,000 is payable to the fellow and $500 is placed at the disposal of the directing professor for necessary materials or equipment. It is expected that four new fellowships will be awarded in 1961.

Applications on behalf of competent graduate students will be considered from any Canadian university qualified to confer the Master's or Doctor's degree in Geology (including Geophysics), Mining, Ore Dressing, Metallurgy (both process and physical), Chemistry (pertaining to metals), Physics (pertaining to metals), and Mathematics. Awards are made by a committee appointed by the National Conference of Canadian Universities and Colleges.

Application should be made to the International Nickel Company of Canada, Limited, 55 Yonge Street, Toronto 1, Ontario, not later than February 14.

THE JOHNSON FOUNDATION SCHOLARSHIP AWARD

The Johnson Foundation through S. C. Johnson and Son Limited, Brantford, Ontario, offers one scholarship each year for study in a United States College or University in postgraduate fields of study such as economics, business administration, chemistry, engineering, teaching, etc.

The amount of the scholarship varies according to the requirements of each student.

Further information may be obtained from S. C. Johnson and Son Limited, Brantford, Ontario, and preliminary application must be received by them not later than December 15th.

MCCHARLES PRIZE

This prize, the gift of the late Æneas McCharles of the value of $1,000, is awarded from time to time but not necessarily every year on the following terms and conditions: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions determine the method of award.

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000) in money.

(3) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(4) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE UNIVERSITY OF MANCHESTER TORONTO FUND

The University of Manchester has accepted the gift of a sum of £1,699 from a Committee representing the parents of children who during the war were evacuated to Toronto and other places in Canada. The capital and any income arising therefrom will be used to make grants to Canadians wishing to conduct post-graduate studies and/or research in the University of Manchester, preference being given to students who have graduated from the University of Toronto. The total amount of grant or grants to any student will not exceed £100. Applications must be submitted to the Registrar of the University of Toronto on or before January 1st of the year in which the applicant wishes to enter the University of Manchester, together with transcripts of undergraduate and graduate record and outlines of the post-graduate studies and/or research to be followed at the University of Manchester.

NATIONAL SEWER PIPE COMPANY LIMITED SCHOLARSHIP

The National Sewer Pipe Company Limited has established a scholarship of a value of Five Hundred Dollars ($500.00) in the School of Graduate Studies. It is awarded annually to a student who undertakes to enroll in that School, proceeding to the degree of Master of Applied Science in the graduate Department of Civil Engineering and in the course in Public Health Engineering.

Applications must be submitted to the Secretary of the School of Graduate Studies on or before March 1st.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering, to be known as The Nipissing Mining Company Research Fellowship, of the annual value of the income from the fund, plus free tuition.

This Fellowship is open to graduates of any University.

H. W. PRICE RESEARCH FELLOWSHIP IN ELECTRICAL ENGINEERING

The H. W. Price Research Fellowship in Electrical Engineering consisting of the income or a part thereof but not exceeding the income for three years derived from the sum of $10,000 donated by the Hydro Electric Power Commission of Ontario, will be awarded from time to time as recommended by the School of Engineering Research, to a graduate in Electrical Engineering of any recognized University, registered in the School of Graduate Studies, wishing to proceed with an investigation in the field of Electrical Engineering.

Forms of application may be obtained from the Secretary, School of Graduate Studies, and should be returned with a statement of qualifications not later than March 1st. The first award was available in 1943.

THE RAYMOND PRIESTLEY FELLOWSHIP

The University of Birmingham being "anxious to mark its indebtedness and its gratitude" for the hospitality shown during the Second World War to children of members of its teaching staff by members of the University of Toronto, has set aside a research fellowship to be held by a graduate of the University of Toronto. This fellowship, to be known as the Raymond Priestley Fellowship, of the value of £450 per annum as well as the cost of the return passage from Canada, is available for graduates, both men and women, preferably those who have already shown some capacity for and interest in research. The fellowship will normally be awarded for a period of three years. It is tenable in any faculty of the University of Birmingham. The Fellow will undertake research and may, if he wishes, be a candidate for a higher degree at the University of Birmingham. The selection of the candidate will be made by the University of Toronto. The process of selection will include negotiation with the head of the department concerned in the University of Birmingham to ensure that there is in the University opportunity

for the pursuit of the particular line of research required. Applications must be submitted to the University Registrar not later than March 1st, together with transcripts of undergraduate and graduate records and outlines of the research to be undertaken at the University of Birmingham.

THE ROYAL INSTITUTION OF GREAT BRITAIN SCIENCE RESEARCH SCHOLARSHIPS

A scholarship of the value of £350 per annum with a possible additional allowance of £50, to be held ordinarily for a period of two years, will be offered each year to a candidate from one of the universities of Canada, Australia, New Zealand and South Africa, and is tenable only in the Davy Faraday Research Laboratory of the Royal Institution, London. No candidates will be considered except those who have been recommended for the 1851 Exhibition Science Research scholarships, and candidates who wish to be considered also for the Royal Institution scholarships are requested to state this clearly in the application for an 1851 scholarship. No other application to the Royal Institution is necessary. Copies of the regulations relating to these scholarships may be obtained from the University Registrar.

THE STEEL COMPANY OF CANADA LIMITED FELLOWSHIPS IN METALLURGY

Four Fellowships, each of the value of $3,000, out of which $2,000 will be awarded to the successful candidate and $1,000 to the university at which he or she studies, are offered to permanent residents of Canada who are graduates of a Canadian university. The fellowships are normally tenable for one year but in special circumstances may be renewed for a second year. Applications must be made in triplicate on the approved form to The Secretary, Canadian Universities Foundation, 77 Metcalfe Street, Ottawa. Forms may be obtained from the relevant department in your university, from the Registrar's office, or from the above address.

SPRUCE FALLS POWER AND PAPER COMPANY, LIMITED, FELLOWSHIP

The Spruce Falls Power and Paper Company Limited has established a Fellowship for the encouragement of research in the Faculty, of an annual value of $1200. It is open to graduates of the University of Toronto or of other recognized universities, but is restricted to Canadian Citizens. Application should be sent to the Secretary of the School of Graduate Studies, not later than March 1st.

The Fellowship also carries a grant of $300 to be applied to the tuition of the holder and $300 to the general University Funds.

THE 1940 TORONTO FUND

The 1940 Toronto Fund, the gift of Oxford University, of the value of £3000, was set up in 1940 by the parents of Oxford children who were taken into Canadian and American homes during the War. Recommendations for grants from the Fund will be made from time to time by the Senate of the University of Toronto to members of the University

"who wish to go to Great Britain for the purpose of study, research, or any general educational purpose, taking education in the widest possible sense." Each applicant for a grant from this Fund must submit his application to the University Registrar not later than March 1st together with an outline of the study or research which he proposes to undertake in Great Britain, or the general educational purpose which he has in mind in going there.

WALLBERG RESEARCH FELLOWSHIPS

Three Wallberg Research Fellowships, each of the value of $2,000 and fees up to $300, are open to graduates of any recognized university who propose to pursue advanced study and research in any branch of Engineering in the University of Toronto.

Forms of application may be obtained from the Secretary of the School of Graduate Studies. These should be returned together with a transcript of academic record and an outline of the proposed study and research not later than March 1st.

THE CHARLES G. WILLIAMS FELLOWSHIP IN URANIUM METALLURGY

Eldorado Mining and Refining Limited offers a postgraduate scholarship in Uranium Metallurgy to a graduate in the physical sciences, pure and applied of a value of $1,500 for an academic year and the holder is also eligible for a supplementary amount of $800 for the summer months. A cash grant to the University accompanies the fellowship.

Application forms may be obtained from the Registrar of the University and submitted to the Secretary, Eldorado Mining and Refining Limited, P.O. Box 379, Ottawa, Ontario, before 15th March.

GARNET W. MCKEE LOAN AND SCHOLARSHIP FUND

The late Mrs. Garnet W. McKee has given this fund to assist students of promise at the University of Toronto, and to develop and extend by research the following subjects studied in the Engineering Physics course in the Faculty of Applied Science and Engineering, especially in their application to the industries of Canada: Electricity and Communications; X-rays and Spectroscopy; Illumination and Acoustics; Geophysics; Refrigeration; Aeronautics.

In each session $800 from the annual income of the fund will be allotted to provide the Garnet W. McKee Scholarship, tenable preferably by a graduate who was eligible for a loan in a previous session, or who is in at least the second year of his graduate work.

Each holder of the said Scholarship and each graduate to whom a loan is granted will be required in the following session to enrol in the School of Graduate Studies and to pursue studies leading to a graduate degree in one or more of the subjects listed, and he may not engage in remunerative employment during the session except by permission of the Committee of Award.

Applications for a loan must be made to the Secretary of the School of Graduate Studies not later than September 1st.

Applications for a Scholarship must be accompanied by an outline of the proposed research problem.

LOAN FUNDS

From the loan funds mentioned below, small loans can be made to students who are in urgent need of assistance. The funds are not large and the loans must accordingly be restricted, both in amount and number, and principally to students in the Third and Fourth Years.

Enquiries for loans from any of the following funds should be made at the office of the Secretary of the Faculty.

- Engineering Alumni Loan Fund
- Engineering Society Loan Fund
- Elizabeth Speller Memorial Fund
- James W. Crocker Memorial Fund
- Harry F. Bennett Educational Fund
- S.A.E.—Canadian Section Loan Fund
- Class of 2T7 (SPS) Memorial Loan Fund
- Avro Aircraft Limited Engineering Loan Fund
- Association of Professional Engineers Loan Fund
- The William Storrie Memorial Fund
- 3T6 Engineers Loan Association
- 4T0 Engineering Loan Fund
- Women's Association of the Mining Industry in Canada Loan Fund
- The Devonshire Loan Fund
- Class of '09 Trust Fund
- University of Toronto Alumni Loan Fund

CLASS OF 1936 LOAN ASSOCIATION

Members of the Class of 1936 have made arrangements to assist students in obtaining loans through regular banking facilities. Information may be obtained from the Secretary of the Faculty.

ENGINEERING ALUMNI LOAN FUND

The Engineering Alumni Association established in 1950 a loan fund to assist engineering students, especially in the Third and Fourth Years.

Applications for loans from this fund should be made to the Secretary of the Faculty.

CLASS OF 2T7 (SPS) MEMORIAL LOAN FUND

This fund was established in 1955 to memorialize the Class of 1927 of the Faculty of Applied Science and Engineering.

Loans to a total of $250 are available to any undergraduate who has completed one Year, with or without conditions, and who has qualified for the Second, Third or Fourth Year.

Application shall be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary of the Faculty.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller, of the Class of 1893, the "Elizabeth Speller Memorial Fund" has been established to provide loans for worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

JAMES W. CROCKER MEMORIAL LOAN FUND

This fund was established by Mrs. William Crocker in memory of her son, James W. Crocker, a graduate in Mining Engineering in 1938, who was killed in an accident in a mine in the same year.

HARRY F. BENNETT EDUCATIONAL FUND

This fund was established by subscription from members of The Engineering Institute of Canada in memory of the late Harry F. Bennett, M.E.I.C., who for six years prior to his death in 1946 was chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, and who accomplished so much in this field by untiring efforts.

One purpose of the fund is to make loans to deserving students who need financial assistance to enable them to study engineering sciences at university level, and who have proved themselves by successfully completing their first year in engineering or the equivalent.

Loans will be made largely on the basis of character and to men who seem likely to develop the high professional standards which are essential to leadership in engineering science. A student who has been aided by this fund should feel that high obligations are placed on him; obligations to the subscribers, to the trustees, and to those coming after him who in turn can receive help as his loan is repaid.

Application forms may be obtained at the Faculty Office. The regulations are simple and the application of any worth-while student will be given immediate and careful attention.

SOCIETY OF AUTOMOTIVE ENGINEERS—CANADIAN SECTION LOAN FUND

The Society of Automotive Engineers—Canadian Section has established a loan fund of $1,200.00 in the Faculty of Applied Science and Engineering. Preference is given to students in good scholastic standing and engaged in studies relative to the automotive and aircraft industries, and to students in fourth, third and second years in that order. Particulars may be obtained from the Secretary of the Faculty.

AVRO AIRCRAFT LIMITED ENGINEERING LOAN FUND

Avro Aircraft Limited has established a Loan Fund of $3,000.00 to provide loans to engineering students requiring financial assistance. Application should be made to the Secretary of the Faculty.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO LOAN FUND

The Association of Professional Engineers has made loans not exceeding $200 available to students in the First, Second and Third Years in this Faculty. Application should be made to the Association at 236 Avenue Road, Toronto.

THE WILLIAM STORRIE MEMORIAL FUND

The William Storrie Memorial Fund has been established by Mrs. William Storrie to provide loans to undergraduates in the course in Civil Engineering. Application should be made to the Secretary of the Faculty.

THE DEVONSHIRE LOAN FUND

This Fund has been established by Graduates and friends of Devonshire House to assist students in the Residence. Application should be made to the Office of the Dean of Devonshire House.

CLASS OF '09 TRUST FUND

The Class of '09 on the 50th Anniversary of their graduation made a sum of money available in the Faculty for financial aid to undergraduates, with preference to Second Year students. Inquiry should be made to the Secretary of the Faculty.

THE UNIVERSITY OF TORONTO ALUMNI LOAN FUND

This fund comes from subscriptions received originally in 1919 and in succeeding years from graduates of the University and is administered by the University of Toronto Alumni Association.

Loans are available to undergraduate and graduate students enrolled in a full time course at the University, in second and subsequent years.

Particulars may be obtained from The University of Toronto Alumni Association, Alumni House, 18 Willcocks Street, Toronto, or from the Secretary of the Faculty or School.

SECTION XI. DISCIPLINE

1. Subject to the general regulations of the Caput of the University regarding jurisdiction in matters of discipline the Council of University College, the governing bodies of the Federated Universities and Affiliated Colleges, and the Councils of the Faculties, Schools, and Institutes have disciplinary jurisdiction over the conduct of all students registered in these Divisions of the University in all matters of local or internal concern to these Divisions. Jurisdiction over the conduct of students while in residence regardless of the Division of the University in which they are registered is vested in the body administering the residence.

2. Jurisdiction concerning conduct likely to affect the interests of the University as a whole is vested in the Caput.

3. The Students' Administrative Council will be supported in the proper performance of all its obligations and duties as provided in its Constitution.

4. Where the appropriate body exercising disciplinary jurisdiction has found that a student of the University has engaged in conduct prejudicial to the interests of the University, the Caput may, in its discretion, suspend or expel such student from the academic privileges of the University. Every decision of the Caput involving the expulsion of a student from the University requires confirmation of the Board of Governors.

5. Any student who interferes with the personal liberty of another or who subjects another student to indignity or personal violence may be considered by the Caput or any other body exercising disciplinary jurisdiction in the University to have committed a breach of discipline.

6. Initiation ceremonies involving physical violence, personal indignity, interference with personal liberty, or destruction of property, may be deemed a breach of discipline by the Caput or any other body exercising disciplinary jurisdiction in the University.

7. Without limiting the disciplinary powers vested in the respective bodies exercising disciplinary jurisdiction as set forth in sections 1–7, the following are cited as illustrations of conduct which, in the past, has been considered a breach of discipline prejudicial to the interests of the University:

- (i) The organising of a parade on the streets of the city or the taking part in such a parade without permission of the authorities.
- (ii) The destruction or defacing of University property, raids on Residences or other University buildings, and the breaking into University buildings.
- (iii) Rowdy and other forms of behaviour, either on or off the Campus, of such an objectionable nature as to bring the University into public disrepute.

8. Student Clubs and Associations

(a) The constitution of every society or association of students in the University and all amendments to such constitutions require to be approved by the relevant University authorities. The giving of approval, and the responsibility for the programmes of student societies and associations, shall rest as follows:

(i) With the authorities of the College, Faculty or School concerned where the membership of the student society or association is drawn from a single College, Faculty or School.

(ii) With the Board of Stewards of Hart House, where the student society or association is a Committee of Hart House and is controlled by the Board of Stewards of Hart House.

(iii) With the Caput, in the case of all other student societies and associations.

(b) No approval will be given by any of the authorities listed in (a) above to the constitution of any society or association of students if that constitution permits:

(i) Membership in the society or association to persons who are not students of the University, unless in the case of the societies listed in (a) (ii) above, where membership is open also to graduates of the University and members of the Faculty of the University.

(ii) Any action of discrimination based upon race, religion, or colour.

9. The name of the University is not to be used in connection with a publication of any kind without permission of the Caput.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1961–62

Year	1	2	3	4	5	6	7	8	9	Total
I	82	13	33	19	101	69	71	11	14	413
II	43	1	43	27	69	57	66	11	5	322
III	54	5	67	18	65	57	68	11	6	351
IV	67	14	69	32	83	48	69	7	11	400
Total	246	33	212	96	318	231	274	40	36	1486
Special Students										6
										1491

INDEX

UNIVERSITY OF TORONTO

CALENDAR

Faculty of Applied Science and Engineering

1963-1964

UNIVERSITY OF TORONTO PRESS
1963

CALENDAR 1963

Jan.

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SECTION 1. CALENDAR 1963–64

FALL TERM, 1963

July 1	*Monday*	Buildings closed.
July 10	*Wednesday*	Last day for receiving applications for supplemental examinations.
August 5	*Monday*	Civic Holiday. Buildings closed.
August 12	*Monday*	Supplemental Examinations commence.
August 19	*Monday*	Students of the III Year, Course 1, report at Survey Camp.
August 26	*Monday*	Students of the III Year, Courses 2 and 9, report at Survey Camp.
September 2	*Monday*	Labour Day. Buildings closed.
September 4	*Wednesday*	Students in II Year, Course 6, report for Analytical Chemistry Laboratory.
September 5	*Thursday*	Special Meeting of Faculty Council.
September 9	*Monday*	Students in IV Year, Course 1, Option B, report at Survey Camp.
September 19 September 20	*Thursday* *Friday*	Registration in person of the I Year from 9:30 a.m. to 12:00 noon and from 2:00 p.m. to 4:30 p.m. in the Galbraith Building.
September 23	*Monday*	Registration in person of the II and III Years from 9:30 a.m. to 12:00 noon and from 2:00 p.m. to 4:30 p.m. in the Galbraith Building. Dean's address to the I Year. Preliminary instruction to the I Year.
September 24	*Tuesday*	Registration in person of the IV Year from 9:30 a.m. to 12:00 noon, and from 2:00 p.m. to 4:30 p.m. in the Galbraith Building. Meeting of Faculty Council.
September 25	*Wednesday*	Lectures and Laboratory work commence at 9:00 a.m. Opening address by the President to the students of all Faculties at 3:45 p.m. in Convocation Hall. Lectures and Laboratory classes withdrawn from 3:00 p.m.
October 3	*Thursday*	Meeting of Faculty Council.
October 11	*Friday*	Meeting of Senate.
October 14	*Monday*	Thanksgiving Day. Buildings closed.
November 3	*Monday*	Meeting of Faculty Council.

November 8	*Friday*	Meeting of Senate.
November 11	*Monday*	Remembrance Day Service 10:45 a.m. Lectures and Laboratory classes withdrawn from 10:00 a.m. to 12:00 noon.
November 22	*Friday*	Fall Convocation.
December 6	*Friday*	Meeting of Faculty Council.
December 13	*Friday*	Meeting of Senate.
December 19	*Thursday*	First Year Term Examinations.
December 20	*Friday*	First Year Term Examinations. Term ends at 5:00 p.m.
December 25	*Wednesday*	Christmas Day.

SPRING TERM, 1964

January 1	*Wednesday*	New Year's Day.
January 6	*Monday*	Spring term begins. Mid session Examinations commence.
January 7	*Tuesday*	Meeting of Faculty Council.
January 10	*Friday*	Meeting of Senate.
January 15	*Wednesday*	Last day for receiving the second term instalment of fees.
January 16	*Thursday*	IV Year Employment interviews.
January 17	*Friday*	IV Year Employment interviews.
January 18	*Saturday*	IV Year Employment interviews.
February 6	*Thursday*	Meeting of Faculty Council.
February 14	*Friday*	Meeting of Senate.
March 4	*Wednesday*	Meeting of Faculty Council.
March 13	*Friday*	Meeting of Senate.
March 27	*Friday*	Good Friday. Buildings closed.
March 28	*Saturday*	Buildings closed.
April 3	*Friday*	Meeting of Faculty Council. Term ends at 5:00 p.m.
April 10	*Friday*	Meeting of Senate.
April 13	*Monday*	Annual Examinations commence.
May 4	*Monday*	Meeting of Faculty Council.
May 8	*Friday*	Meeting of Senate.
May 18	*Monday*	Victoria Day. Buildings closed.
June 1	*Monday*	University Commencement.
June 2	*Tuesday*	University Commencement.
June 3	*Wednesday*	University Commencement.
June 4	*Thursday*	University Commencement.
June 5	*Friday*	University Commencement.

SECTION II. ADMINISTRATIVE OFFICERS

1962–63

THE UNIVERSITY

President . . . . C. T. Bissell, M.A., PH.D., D.LITT., LL.D., F.R.S.C.
Executive Assistant to the President . . . . J. H. Sword, M.A.

Registrar . . . . R. Ross, M.B.E., M.A.
Chief Librarian . . . . R. H. Blackburn, M.A., B.L.S., M.S.
Director of University Extension . . . D. C. Williams, M.A., PH.D.
Chairman of the Medical Sciences Advisory Council
J. A. MacFarlane, O.B.E., E.D., B.A., M.B., LL.D., F.R.C.S.

Vice-President (Administration) . . . . F. R. Stone, B.COM., F.C.A.
Comptroller . . . . G. L. Court, D.F.C., M.COM., C.A.
Secretary of the Board of Governors . . . . J. F. Brook
Superintendent of Buildings and Grounds . F. J. Hastie, B.SC., P.ENG.
Chief Accountant . . . . D. J. Reid

Director of the University of Toronto Press . . . M. Jeanneret, B.A.

Director of Alumni Affairs . . . . J. C. Evans, B.A.
Director of Information . . . . K. S. Edey
Director of Development . . . . R. J. Albrant
Director of Graduate Records . . . . . C. G. M. Grier, E.D., M.A.

Warden of Hart House . . . . J. McCulley, M.A.
Director of University Health Service
G. E. Wodehouse, M.C., M.D., F.R.C.P.
Assistant Director of University Health Service—Women
Miss F. H. Stewart, B.A., M.D.
Director of the Placement Service . . J. K. Bradford, O.B.E., M.A.SC.
Director of Athletics and Physical Education—Men W. A. Stevens, B.S.
Director of Athletics and Physical Education—Women Miss Z. Slack, B.A.
General Secretary-Treasurer of the Students' Administrative Council
E. A. Macdonald, B.A.
Director Hart House Theatre . . . . R. S. Gill, M.A.

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean . . . . R. R. McLaughlin, M.A.SC., M.A., PH.D.
Secretary . . . . J. A. Gow, B.A.SC
Assistant Secretary . . . . W. H. Sisson, B.A.SC.

SECTION III. TEACHING STAFF

1962–63

DEAN EMERITUS

C. R. YOUNG, B.A.SC., C.E., LL.D., D.ENG., D.ÈS.SC.A., HON. M.E.I.C., M.AM.SOC.C.E. — 2904 Yonge St.
Dean Emeritus, Faculty of Applied Science and Engineering

PROFESSORES EMERITI

E. A. ALLCUT, M.SC. (BIRM.), M.E., F.R.AE.S., — 315 Lawrence Ave. W.
Professor Emeritus of Mechanical Engineering

E. G. R. ARDAGH, B.A.SC., F.C.I.C., F.R.S.C. — 219 Old Yonge St.

J. W. BAIN, B.A.SC., LL.D., F.R.S.C. — 30 Burton Rd.

E. A. SMITH, M.A. (MCM.) — Gormley
Professors Emeriti of Chemical Engineering

J. R. COCKBURN, M.C., V.D., B.A.SC. — 100 Walmer Rd.
Professor Emeritus of Engineering Drawing

T. R. LOUDON, V.D., B.A.SC., C.E., HON. F.C.A.I., HON. M.E.I.C. — 189 Sheldrake Blvd.
Professor Emeritus of Civil and Aeronautical Engineering

W. J. T. WRIGHT, M.B.E., B.A.SC., B.A. — 126 Melrose Ave.
Professor Emeritus of Engineering Drawing

DEPARTMENT OF APPLIED PHYSICS

Professor and Head of the Department

K. B. JACKSON, B.A.SC., D.SC.(WATERLOO) — 362 Glengrove Ave. W.

Associate Professor

V. L. HENDERSON, B.A.SC., A.M.(MICH.) — 397 Glengrove Ave. W.

Assistant Professor

F. B. FRIEND, B.A.(MCM.), M.A.(ROCH.) — 25 Lockie Ave., Agincourt

Lecturers

J. R. BIRD, B.A.SC., M.A., PH.D. — 28 Brownlow Ave.

MISS M. G. CURRIE, B.A.SC. — 89 Broadway Ave.

D. J. GERRARD, B.SC.F. — 70 Rowanwood Ave.

L. M. STEINBERG, M.A. — 54 St.Patrick St.

J. VLCEK, B.SC.F. (U.N.B.) M.A.SC. — 15 Talwood Dr., Don Mills

Lecturer (part-time)

J. CHISVIN, B.SC.(MAN.) — 143 Waterloo Ave., Haviland P.O.

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

Professor and Head of the Department

J. G. Breckenridge, b.a.sc., ph.d. (cantab.) — 23 Douglas Cres.

Professors

W. F. Graydon, m.a.sc., ph.d. (minn.) — North Drive, R.R.1, Islington
R. R. McLaughlin, m.a.sc., m.a., ph.d. — 102 Glen Rd.
W. H. Rapson, m.a.sc., ph.d. — 53 Pine Cres.

Associate Professors

W. H. Burgess, b.ch.e., m.f.s., ph.d. (corn.) — 57 Ridley Blvd.
R. E. Jervis, m.a., ph.d. — 21 High Hill Dr., Agincourt
W. G. MacElhinney, m.a.sc. — 1459 Stavebank Rd., Port Credit
R. W. Missen, m.sc. (qu.), ph.d. (cantab.) — 648 Broadway Ave.
S. Sandler, m.a.sc. — 5 Evanston Dr., Downsview
I. H. Spinner, m.a.sc., ph.d. — 28 Sealcove Dr., Etobicoke
O. Trass, b.s.e. (princ.), sc.d. (m.i.t.) — Apt. 409, 206 St. George St.

Associate Professor of Nuclear Engineering

D. G. Andrews, m.a. (cantab.) — 450 Saville Cres., Oakville

Assistant Professors

R. L. Hummel, b.s. (purdue), ph.d. (iowa) — Apt. 6, 68 Kendal Ave.
J. W. Smith, m.a.sc. (u.b.c.), ph.d. (lond.) — 193 Millwood Rd.

Lecturers

C. C. Barnes, b.sc. (qu.) — 894 Avenue Rd.
J. Binkiewicz, dip.chem.eng. (lwow) — 38 Nina St.
Z. May, dip.ing.chem. (warsaw) — 29 Linden St.
M. B. Moo-Young, m.a.sc., ph.d. (lond.) — 120 Bedford Rd.
Miss M. J. Phillips, m.a. (bryn mawr), ph.d. (j.h.u.) — 123 Glengrove Ave. W.

Special Lecturer

C. P. Brockett, b.sc. (m.i.t.) — 60 Crescent Rd.

Special Part-time Lecturer

O. W. Berg, fil.kand (lund), m.a. — 230 Spadina Rd.

Instructors

J. K. Affleck, b.a.sc. — 459 Glengarry Ave.
H. A. Fair, b.a.sc. — 126 Rykert Cres.
O. B. Phillips, b.sc. (mcg.) — 22 Montclair Ave.

Instructor (part-time)

J. J. Steyn, b.a., b.a.i. (dub.), m.a.sc. — Apt. 8, 467 Spadina Rd.

Demonstrator

M. Bergman, dip.chem.eng. (zur.), ph.d. (geneva) — 931 College St., Y.M.C.A.

Demonstrators (part-time)

H. J. Barton, m.a.sc.	51 Hocken Ave.
W. C. Brennan, b.a.sc.	68 Fallingbrook Rd.
C.-Y. Ch[illegible]n, b.sc.(taiwan)	229 Beverley St.
H. A. Clarke, b.sc.(lond.), dip.chem.tech.(u.c.w.i.)	Apt. 204, 214 St. George St.
J.-C. Corbi, b.sc.(alex.), m.a.sc.	Apt. 26, 21 Avenue Rd.
W. J. Dowkes, b.a.sc.	11 Roxborough St. W.
R. F. Hunter, b.a.sc.	Apt. 318, 56 Ranleigh Ave.
H. P. Kasserra, b.a.sc.	404 Huron St.
C. J. Mackie, b.sc.(birm.)	146 Wellesley St. E.
W. Metanomski, b.sc.(lond.) m.a.sc.	196 Westminster Ave.
S. R. Rao, b.sc., m.sc.(calcutta)	67 Sussex Ave.
S. Ray, b.sc.(calcutta)	694 Spadina Ave.
M. T. Scholtz, b.sc.(cape town), m.a.sc.	93 Bedford Rd.
S. Sivaramakrishnan, b.sc.(india), m.a.	586 Spadina Ave.
H. Sloan, b.sc.(lond.), ph.d.(dub.)	Apt. 46, 1574 Bathurst St.
M. N. Subrahmanyam, b.sc.(mysore), d.i.i.sc.	414 Huron St.

DEPARTMENT OF CIVIL ENGINEERING

Professor and Head of the Department

C. F. Morrison, b.e.(sask.), m.sc.(mcg.)	21 Douglas Cres.

Professors

M. W. Huggins, m.a.sc.	531 Windermere Ave.
O. J. Marshall, b.a.sc., c.e., o.l.s.	48 Haddinton Ave.
W. L. Sagar, e.d., b.a.sc., c.e.	5 DuMaurier Blvd.

Associate Professors

A. C. Davidson, b.sc., c.e., b.sc., e.e.(man.), m.a.sc.	106 Bideford St.
M. M. Davis, b.sc.(qu.), m.sc.(purdue)	112 Three Valleys Dr.
F. A. De Lory, b.eng.(mcg.), m.a.sc., d.i.c.(imp.), ph.d.(lond.)	34 Farnham Ave.
C. E. Helwig, m.a.sc.	89 Woodlawn Ave. W.
C. Hershfield, b.sc.(man.), m.a.sc.	3 Windmill Rd.
G. Kani, dr.ing.(stuttgart)	57 Castle Frank Cres.
H. L. Macklin, b.a.sc., o.l.s., d.l.s.	29 Blyth Hill Rd.
C. A. Wrenshall, b.e.(sask.)	358 Spring Garden Ave.

Assistant Professors

J. D. Barber, m.a.sc.	7 Wythenshawe Wood
A. P. Bernhart, dipl.ing.(graz), dr.tech.(graz)	23 Cheritan Ave.
R. A. Collins, b.a.sc., m.s.(ill.), ph.d.(ill.)	44 Chatsworth Dr.
C. W. Dillane, b.a.sc.	44 Oriole Pkwy. Apt. 101
H. R. Frizzle, b.sc., e.e.(n.s.tech.)	29 Anndale Dr.
B. J. Haynes, b.a.sc., o.l.s.	8 Devrock Cres.
D. J. L. Kennedy, b.a.sc., m.s.(ill.), ph.d.(ill.)	32 Deevale Rd.
J. Schwaighofer, dipl.ing.(graz.), m.s.(penn st.), ph.d.(penn st.)	268 Poplar Plains Rd.
S. M. Uzumeri, m.a.sc.	427 Balliol St.

Lecturers

S. J. G. Bird, B.A.SC., O.L.S.	281 St. Clements Ave.
V. P. Borecky, DIPL.ING. (PRAGUE), M.A.	265 Ellis Ave.
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R. C. Gunn, M.A.SC.	(On leave of absence for the session)
G. W. Heinke, M.A.SC.	129 Beaver Bend Cresc., Islington
E. Karuks, M.A.SC.	35 Burgess Ave.
K. Meipoom, M.A.SC.	24 Farnham Ave.
J. Timusk, M.A.SC.	276 St. George St.
R. G. Tress, B.A.SC.	2082 Dickson Rd., Cooksville
A. W. Walker, M.A.	31 Alexander St.
G. T. Will, B.A.SC.	108 Isabella St.
P. Wodzianski, MGR.PH. (WARSAW)	111 Park Home Ave.

Special Lecturers

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M. G. Tallon, B.A.SC.	80 Chelford Rd.

Instructors

H. T. Donaldson, B.A. (QUEEN'S)	149 Glenwood Cresc.
S. L. Grenzebach, B.A.SC.	198 St. Leonards Ave.
L. M. Phillips (MISS), M.A.	35 Hawthorne Ave.
A. A. Rose, B.A.SC.	20 Whitelock Cres.
G. H. Wilkes, B.A.SC.	2330 Sheppard Ave. W.

DEPARTMENT OF ELECTRICAL ENGINEERING

Professor and Head of the Department

G. F. Tracy, B.A.SC., S.M. (M.I.T.)	153 Strathallan Blvd.

Professors

J. M. Ham, B.A.SC., SC.D. (M.I.T.)	135 Glencairn Ave.
N. F. Moody, B.SC.	128 Craighurst St.
J. E. Reid, B.A.SC.	152 Donegal Dr.
G. Sinclair, M.SC. (ALTA.), PH.D. (OHIO STATE)	62 Felbrigg Ave.
V. G. Smith, B.A.SC.	142 Dawlish Ave.

Associate Professors

P. P. Biringer, DIP.ING. (BUD.), M.SC. (STOCKHOLM), PH.D.	6 Lumley Ave.
A J. Kravetz, B.SC. (ALTA.), M.A.SC.	500 Riverside Dr.
G. R. Slemon, M.A.SC., PH.D. (LOND.), D.I.C. (IMPERIAL COLL.)	40 Chatfield Dr.
J. L. Yen, B.SC. (CHIAO TUNG), M.A.SC., PH.D.	20 Swiftdale Pl.

Assistant Professors

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SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant-Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers, and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate, by statute subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909–1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910–1911. In the session 1923–24 the degree was changed to B. Arch. for the students graduating in Architecture. On July 1, 1948, the School of Architecture was separated from the Faculty and became an independent School with its own Director and Council.

With the end of the Second World War during the summer of 1945 the University was faced with the difficult problem of providing accom-

modation for almost double the number of students that had been registered in the previous year. Through the efforts of the Chairman of the Board of Governors and the President, the University leased from the Crown part of the large shell-filling plant at Ajax, twenty-five miles east of Toronto, to relieve the heavy demand for space at Queen's Park. Because it became evident, at an early stage, that a relatively large number of students would register in the Faculty of Applied Science and Engineering, it was decided that the work of the First and Second Years of this Faculty should be given at Ajax.

A special First Year session with approximately 1400 students commenced at Ajax on January 14, 1946. In the regular 1946–47 session both First and Second Year instruction, except Second Year in Architecture, was given at Ajax with 1800 registered in the First Year and 1500 in the Second Year. In the 1947–48 session the enrolment at Ajax consisted of 1200 students in the First Year and 1400 in the Second Year. In the session 1948–49, 600 were registered at Ajax in the First Year and 975 in the Second Year. All other instruction was given in Toronto.

To provide for this self-contained University community at Ajax, there were 446 acres and 111 buildings. The University operated such services as central heating, road maintenance, water supply, sewage disposal, fire department, transportation, post office, laundry, private hospital, cafeteria, tuck shop and barber shop. Former production-line buildings were altered to accommodate 37 lecture rooms, 20 draughting rooms and 14 laboratories. In the 1946–47 session, 2300 students were in residence, in 1947–48 there were 1800 students and in 1948–49 there were 900. Student life at Ajax compared favourably with that in Toronto, excellent accommodation being provided for a general circulating library, a technical library, Hart House Ajax, the Athletic Association, the Health Service, Students' Administrative Council, Advisory Bureau for Ex-Service Students, and a small chapel.

Meanwhile, the erection of the Wallberg Building and an addition to the Mechanical Building was in progress, and with this additional accommodation becoming available on the Queen's Park campus, Ajax was closed on May 31, 1949.

The long-felt need for additional space for Civil Engineering and Electrical Engineering, and the projected expansion of the University as a whole to meet the expected demand for greatly enlarged enrollment, led to the construction of the Galbraith Building. Partially occupied during the 1960–61 session it was officially opened on March 7th, 1961, by the Honourable J. Keiller Mackay, D.S.O., V.D., Q.C., LL.D., D.C.L., Lieutenant Governor of Ontario. The building houses Civil Engineering, Electrical Engineering, the Institute of Aerophysics, and the Faculty Office.

SECTION V. GENERAL INFORMATION, ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

RESTRICTION OF REGISTRATION

The right is reserved to limit the number of students admitted to any course in the Faculty.

1. ADMISSION REQUIREMENTS

A candidate for admission to the first year must present the Ontario Grade XIII certificate or an equivalent certificate showing standing in the following subjects:

English:	Literature Composition	
Mathematics:	Algebra Geometry Trigonometry	
Science:	Chemistry Physics	
One of:	French German Greek Italian Latin Spanish Russian	*Authors and Composition*

For admission to Civil, Mining, Mechanical, Industrial, Chemical, Electrical and Metallurgical Engineering, and to Applied Geology, an overall average of at least 64% on these subjects is required.

For admission to Engineering Science, an overall average of at least 70% on these subjects is required. Further information concerning the course in Engineering Science will be found on page 45 of this calendar. Students intending to pursue work in Aeronautical/Astronautical Engineering will register in Engineering Science. For further information, refer to pages 45 and 63.

Preferential consideration will be given to candidates who have completed the University admission requirements at the end of one session in Grade XIII in Ontario schools or in one sitting in other school systems. Applications will also be considered in the light of the Principal's Report, the previous school record of the applicant and other tests of the student's ability that are available.

2. EQUIVALENT CERTIFICATES

The following certificates are usually accepted as equivalent to Ontario Grade 13 although individual subjects cannot always be equated. Standing in the following certificates is required as outlined in (1) above. Specific details on the standing required from applicants who have not been educated in Ontario will be supplied by the Department of Admissions, Office of the Registrar, on request.

CANADA:

Alberta, Manitoba, Nova Scotia, Saskatchewan—Grade 12.
British Columbia, New Brunswick—Senior Matriculation.
Newfoundland—First Year Memorial University.
Prince Edward Island—Third Year Certificate of Prince of Wales College.
Quebec—Senior High School Leaving Certificate; McGill Senior School Certificate; English Catholic Senior High School Leaving Certificate (5th Year High—Grade XII).

ENGLAND, WEST INDIES, EAST AND WEST AFRICA:

General Certificate of Education showing either
(a) Passes in five subjects of which at least two must be passed at advanced level; or
(b) Passes in four subjects of which at least three must be passed at advanced level.

In either case, passes are required in Physics, Chemistry, and an acceptable mathematical subject. At least two of these must be at advanced level.

School and Higher School Certificates are accepted on the following basis:

Credits on the School Certificate are accepted as ordinary level passes on the General Certificate of Education; subsidiary passes on the Higher School Certificate as ordinary level passes on the General Certificate of Education; and principal or main subject passes on the Higher School Certificate as advanced level passes on the General Certificate of Education.

HONG KONG:

General Certificate of Education or School and Higher School Certificates as stated above; or University of Hong Kong Matriculation Certificate on same basis as General Certificate of Education.

UNITED STATES OF AMERICA:

A United States High School Graduation Diploma will not admit an applicant to this Faculty.

First Year College credits in the required subjects from accredited institutions will be accepted for admission, provided satisfactory standing is obtained and the approximate number of semester hours of credit obtained as indicated:

English (including an intensive course in Literature)	6
Algebra	3
Analytical Geometry	3
Plane Trigonometry	3
Physics	3
Chemistry	3
A language other than English	6

An applicant offering a non-Canadian certificate is required to submit to the Registrar of the University for evaluation a photostatic copy of his certificate, indicating the subjects studied and the grades secured. When these certificates are in a language other than English, notarized English translations must accompany the photostatic copies. When the certificates do not indicate the subjects studied and the grades secured in the individual subjects in the final year, candidates are required to submit certified statements from authorized officials of the institutions attended, or to submit statutory declarations giving the required information.

3. ENGLISH FACILITY REQUIREMENTS

All applicants are required to submit evidence of facility in English acceptable to the University of Toronto. The following evidence is acceptable:

(a) The University of Michigan English Language Test. This test is conducted periodically at the University of Toronto for residents in the Toronto area. Applications to write the test in Toronto may be obtained from the Department of Admissions, Simcoe Hall, University of Toronto.

(b) The Certificate of Proficiency in English issued by the Universities of Cambridge or Michigan.

Information about writing the tests in (a) or (b) above in overseas centres may be obtained from the Department of Admissions, Simcoe Hall, University of Toronto.

(c) Standing in English Composition in the Ontario Grade XIII Certificate, or other certificates recognized by the University of Toronto as equivalent.

The University is prepared to consider other evidence of English Facility which may be submitted for evaluation to the Registrar of the University.

4. MATURE STUDENTS

(a) *Admission Regulations*

Candidates of mature age (30 years or older on October 1 of the regular session, or July 1 of the summer session, to which admission is sought) who have lived in Ontario for a minimum period of one year, may request special consideration if they have not completed in full the published Grade XIII (or equivalent) requirements. Such applicants must submit a birth certificate at the time of application.

(b) *Probationary Status*
Candidates accepted by the Senate's Committee on Admissions as mature students are admitted on probation.
Mature students, registered in full-time day courses, must obtain standing in their first year of full-time study in order to have their probationary status removed. If they do not obtain standing they will not be allowed to repeat the year or to enrol in any other course in the University until they present in full the published admission requirements.

5. ADMISSION REGULATIONS CONCERNING CANDIDATES WHO HAVE PREVIOUSLY FAILED IN UNIVERSITY WORK

(a) A candidate who, on one occasion has failed to secure the right to advance to a higher year at the University of Toronto or at any other institution of higher learning, may be eligible for selection to the Uinversity of Toronto subject to debarment.
(b) A student who on two occasions has failed to secure the right to advance to a higher year in university work is debarred from registration in any division of the University of Toronto affected by the debarment regulations of the Senate (see page 25 of this Calendar).

6. PROCEDURE FOR APPLICATION

Application forms may be obtained from the Department of Admissions, Office of the University Registrar, Simcoe Hall, University of Toronto. Applications for admission to undergraduate degree and diploma courses should be completed in accordance with the procedures outlined below and *should be submitted as early as possible in the year for which the candidate seeks admission.*

Provisional Admission Arrangements
Well-qualified Ontario applicants who apply before March 1 will receive Provisional Admission on the basis of the High School records and other information. Such applicants will receive automatic confirmation of this preliminary offer of admission, if they achieve in their Ontario Grade XIII examinations a stated overall average (specified in the letter of provisional admission) and if they meet the subject requirements for the course of their choice.

Terminal Dates for Submission of Applications and Certificates
1. March 1, 1963—Applications for Provisional Admission.
2. June 1, 1963—All other applications (except for General Course—Extension, winter session, which must be submitted by Sept. 1). Only in circumstances which the Committee on Admissions deems exceptional will a late application be considered.

3. Aug. 26, 1963—All certificates which have been issued before this date.
4. Sept. 1, 1963—Certificates issued on or after Aug. 26, 1963.

Application for Admission to First Year

A candidate seeking admission to undergraduate degree and diploma courses must submit to the Department of Admissions, Office of the University Registrar, Simcoe Hall, completed application forms and the following documents:

(i) Ontario Grade XIII or an equivalent certificate, indicating the subjects studied and the grades obtained;

(ii) A candidate who has previously attended a university or college for *any* period of time, must submit the following:

- (a) Official transcripts issued by the University or College previously attended, giving in detail the courses completed, with the standing and grades in each. Transcripts or a supporting letter from the Registrar of the University or College must indicate that the candidate has been granted honourable dismissal and is not debarred from returning to the institution concerned in the session to which he seeks admission in the University of Toronto.
- (b) A calendar of the university giving full descriptions of the courses studied.

Application for Admission with Advanced Standing

A candidate seeking admission on an advanced standing basis must submit to the Department of Admissions, Office of the University Registrar, Simcoe Hall, prior to the dates mentioned above, his completed application form and the documents outlined in 6(i) and (ii) above.

7. PROCEDURE FOR REGISTRATION

Detailed instructions concerning Registration and Health Requirements will be mailed to returning and newly admitted students before the beginning of each academic year.

8. HEALTH REQUIREMENTS

Every person admitted to the University as an undergraduate must, at the time of his or her first medical examination by the University Health Service, present satisfactory evidence of successful vaccination within three years prior to the date of the examination, or must be vaccinated by the examining physician.

9. PROCEDURE FOR WITHDRAWALS OR TRANSFERS

A student who wishes to withdraw or to change his course or division in the University should consult his College Registrar or Faculty/School Secretary.

10. DEBARMENT REGULATIONS OF THE UNIVERSITY*

Subject to other statutes and regulations of the University,

(a) any student who on two occasions fails to secure the right to advance to a higher year in University work will be debarred from further registration in the University.

(b) any student who withdraws after February 15, or who does not withdraw but does not write the annual examinations, will be regarded for the purposes of debarment from the University as having failed his year.

Procedure for Submission of Petitions against Debarment

Petitions relating to the debarment regulations will in the first instance be submitted by the appellant to the Office of the University Registrar for consideration by the Senate's Committee on Applications and Memorials.

SPECIAL STUDENTS

Graduates of the University of Toronto and of recognized universities who wish to take one or more undergraduate subjects may be registered as special students in the Faculty of Applied Science and Engineering, subject to the approval of the teaching department concerned. Application must be made to the Secretary of the Faculty.

RESIDENCE ACCOMMODATION

There is a University Men's Residence (Devonshire House) for which men undergraduates are eligible but which can accommodate only a small percentage of them. Early application is advisable. Apply to the Secretary, Men's Residences, Simcoe Hall.

Each of the four Arts Colleges also maintains a Men's Residence into which some engineering students are accepted. Further information may be obtained from:

University College—Dean of Men
Victoria College—Senior Tutor
Trinity College—Registrar, Trinity College
St. Michael's College—The Superior

HOUSING SERVICE

For those students who are not accommodated in the University and the College residences, the Students' Administrative Council prepares

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*These regulations apply to students enrolled in all Divisions of the University *except* the Faculty of Law, the Professional years in the Faculty of Medicine, the School of Social Work, the Ontario College of Education, Library School, the School of Graduate Studies and all other Post Graduate Divisions of the University.

annually a list of rooming houses, flats, apartments, and homes. Listings and information may be obtained at the Housing Service Office in the Students' Administrative Council Building. The Service is available for both regular term and summer students from early in the summer and throughout the session.

To meet the housing shortage in Toronto, the Students' Administrative Council has greatly expanded its Housing Service. To provide the most adequate facilities, the Service inspects as many homes as possible for safety and sanitation, space and furnishings, and compliance with municipal by-laws and with discrimination legislation. Every effort is being made to provide family accommodation for married students.

Through this Service some opportunities have been afforded students, including students who are married, to obtain lodgings and board in exchange for part-time service. Students desiring this type of accommodation are asked to indicate this when they visit the Service.

CHILDREN OF WAR DEAD (EDUCATION ASSISTANCE) ACT

Children of War Dead (Education Assistance) Act provides fees and monthly allowances for children of veterans whose death was attributable to military service. Enquiries should be directed to the nearest District Office of the Department of Veterans Affairs.

SECTION VI. FEES, DEPOSITS AND EXPENSES

FEES

1. A student who desires to enrol in the Faculty of Applied Science and Engineering is required to pay at least the First Term Instalment of fees on or before the opening date of the session, and before he can receive his registration card from the Secretary of the Faculty. The amount of the First Term Instalment of fees or of the Total Fee for the session may be ascertained from the schedule of fees below.

2. The Second Term Instalment of fees, if not already paid, is payable on or before January 15. After this date an additional fee of $3.00 per month or portion thereof (not exceeding $10.00), will be imposed until the whole amount is paid. All fees for the session must have been paid in full before the student can be admitted to the annual examinations.

3. In order to avoid delay in registration at the opening of the session it is recommended that at least the First Term Instalment of fees be forwarded by mail as early as possible in September, together with a form, in duplicate, to be provided by the Secretary of the Faculty and filled out by the student, giving his full name, course, year, etc.

4. University fees are payable at the Office of the Chief Accountant, Simcoe Hall, which will be open for the receipt of fees from 9 a.m. to 5 p.m. daily from September 10 to 24 (Saturdays 9–12) and from 9 a.m. to 1 p.m. daily except Saturday during the remainder of the session. Cheques in payment of these fees should be made payable to the University of Toronto at par in Toronto.

5. Each undergraduate enrolled in the Faculty of Applied Science and Engineering must pay annual fees to the Chief Accountant according to the schedule below; the total fee in each case is made up of the academic fee and incidental fees; all incidental fees are payable in the first term.

Schedule of Fees

Academic Year	*Academic Fee	†Incidental Fees	Total Fee (if paid in one instalment)	First Term Instalment	Second Term Instalment
Men					
I-IV	$600	$57	$657	$357	$303
Women					
I-IV	$600	$31	$631	$331	$303

*The Academic Fee includes the following fees:—
Tuition; Library and Laboratory Supply; one Annual Examination; Laboratory Fee; Physical Education; and Degree.

†These Incidental Fees include the following fees:—
For men—Hart House; Students' Administrative Council; Athletic; Health Service; Engineering Society; Faculty Athletic Association.
For women—Students' Administrative Council; Athletic; Health Service; Engineering Society.

6. A late registration fee of $10.00 will be assessed against any student who registers after the last date for normal registration in his or her faculty or school.

OTHER UNIVERSITY FEES

7. Each student is required to pay to the Chief Accountant at the opening of the session, or as otherwise specified, such of the following fees as may be required of him.

EQUIVALENT CERTIFICATE FEE

8. Each student who has been admitted to the First Year upon a certificate or certificates granted outside the Province of Ontario and covering all or any part of the admission requirements, must pay a fee of $5.00.

ADVANCED STANDING FEE

9. Each student who has been admitted to advanced standing from another university or college, must pay a fee of $10.00.

SPECIAL PHYSICAL EDUCATION FEE

10. Each student who has neglected to complete satisfactorily the course in Physical Education of the First Year, and who must take this work during the Second Year of his or her attendance must pay a fee of $50.00.

SUPPLEMENTAL EXAMINATION FEES

11. Each candidate for a supplemental examination is required to pay a fee to the Chief Accountant not later than July 31. The fee is $10.00 for one subject and $5 for each additional subject, including laboratory supplementals. For each supplemental examination in a laboratory subject requiring special supervision, there is an additional fee of $10.00. The additional laboratory supplemental fee should not be paid until the candidate is notified by the Secretary.

SPECIAL STUDENTS FEES

12. The fee is $85.00 per subject, payable to the Chief Accountant.

SUMMARY OF STUDENTS' EXPENSES

13. The following approximate statement of expenses will give the student a general idea of the cost of obtaining an education in the Faculty of Applied Science and Engineering in the University of Toronto, exclusive of personal expenses:—

1. Fees, see schedule page 27.
2. Board and Lodging, per week ....$20.00 up
3. Books and instruments, per year ....about $100

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating course in which he intends to proceed to a degree. There are nine courses in Engineering, from which the selection may be made, viz.,

Civil Engineering (Course 1),
Mining Engineering (Course 2),
Mechanical Engineering (Course 3),
Industrial Engineering (Course 4),
Engineering Science (Course 5), (formerly Engineering Physics)
Chemical Engineering (Course 6),
Electrical Engineering (Course 7),
Metallurgical Engineering (Course 8),
Applied Geology (Course 9),
Aeronautical/Astronautical Engineering (see page 63).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the above courses.

3. The courses extend over four academic years. A student must pass in the work of each academic year before proceeding to the work of the next. See Sec. IX.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 15.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction are given in Sec. VIII.

7. Examinations are conducted as explained in Sec. IX.

8. Students in Civil Engineering, Mining Engineering, Mechanical Engineering, Industrial Engineering, Chemical Engineering, Electrical Engineering, Metallurgical Engineering and Applied Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. (See Sec. VIII.)

GRADUATE STUDY AND RESEARCH

Facilities are available in the Departments of the Faculty, for graduates with good records of this University or of another University of comparable standing, for post-graduate study and research leading to

the degrees of Master of Applied Science (M.A.Sc.) and Doctor of Philosophy (Ph.D.). For further information see the Calendar of the School of Graduate Studies. Many graduate students receive financial support for equipment, and salaried appointments as research assistants, through a variety of research grants originating both within and outside the University.

Bursaries and Scholarships for graduate students are available in limited number as shown on page 171. Many part-time demonstratorships are open which permit post-graduate work towards a degree.

DIPLOMA COURSE IN OPERATIONS RESEARCH

A one-year diploma course in Operations Research is offered for those who have obtained a bachelor's degree in engineering, science, or mathematics. The diploma course is designed specifically to meet the needs of people who are presently employed in industry and who aspire to develop special skills in the design, analysis, and control of complex organizational systems.

Inquires regarding the Diploma Course in Operations Research should be directed to the Secretary, Faculty of Applied Science and Engineering.

INTERIM HIGH SCHOOL ASSISTANT'S CERTIFICATE TYPE A

Graduation in Engineering Physics is accepted by the Ontario College of Education as meeting the academic requirements for admission to the course leading to a Type A certificate in Mathematics and Physics.

Graduates in other engineering courses such as Electrical Engineering or Chemical Engineering may also be admitted to Type A Certificate courses at the Ontario College of Education if they submit official transcripts which indicate that they have sufficient academic credits.

Graduates in engineering courses who lack sufficient academic credits for admission to Type A courses at the Ontario College of Education may be eligible for admission to the Type B course and later for endorsement of the Type B Certificate in Mathematics and Physics.

Inquiries regarding endorsement of Type B Certificates or admission to Type A Certificate courses should be directed to the Director, Advanced Academic Recommendations, Ontario College of Education.

ASSOCIATIONS OF PROFESSIONAL ENGINEERS

Graduation from the Faculty of Applied Science and Engineering leads to registration as a Professional Engineer in the various Associations of Professional Engineers throughout Canada.

SECTION VIII. CURRICULUM

The courses are designed to give the student a thorough grounding in the fundamentals of engineering, with emphasis on their practical application in the field in which he has chosen to study. In the First Year there is little differentiation between the various courses with the exception of Engineering Science. In the succeeding years, specialization develops to a considerable extent, with provision in the Third and Fourth Years for optional subjects in some of the courses.

The Faculty has excellent laboratory facilities, in which the students do practical experiments and problems related to the lecture subjects. In some graduating courses, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances, the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. As part of the laboratory instruction, excursions to places of technical interest are arranged by the staff. These excursions are treated as laboratory periods, with the same requirements as to attendance and reports.

In the teaching of fundamentals, instruction is not confined wholly to Applied Science. As engineering works necessarily involve considerations of organization, economics and finance, it is essential that those entering the profession should have a basic knowledge of these subjects.

As in the case with other professions, the engineer should be prepared to assume positions of professional and community leadership. Accordingly, the curriculum contains a basic core of humanistic-social studies, including English, Political Science, Economics, Modern History, and Philosophy of Science. It is hoped that this introduction to the humanities will stimulate the student to do further reading and study, thereby increasing his professional effectiveness.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The programme and regulations regarding the courses of study and examination, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course to the conditions here laid down.

Communications relating to curricula, instruction, and examinations in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information regarding the courses of study leading to the post-graduate degrees, Master of Applied Science, and Doctor of Philosophy, see the calendar of the School of Graduate Studies, which gives full particulars.

FIRST YEAR CURRICULUM

The courses in Mechanical Engineering. Industrial Engineering, Chemical Engineering, Electrical Engineering and Metallurgical Engineering, designated as Division A have a common First Year and the courses in Civil Engineering, Mining Engineering and Applied Geology have a common First Year differing from that of Division A only in that Surveying is included. The First Year curriculum in Engineering Science is designated as Division C.

A student, on petition to the Council, may be permitted to change his course at the end of the First Year.

FIRST YEAR CURRICULUM

Division A		Division B
Mechanical Engineering Industrial Engineering Chemical Engineering Electrical Engineering Metallurgical Engineering	AND	Civil Engineering Mining Engineering Applied Geology

First Year Subjects Divisions A & B	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	600, 601	2	3	2	3
Engineering Problems and Drawing	137	–	6	–	6
English	2110	2	–	2	–
Mathematics:					
Calculus, Analytical Geometry and Algebra	2410, 137	3	3	3	3
Descriptive Geometry	135	1		1	
Physics:					
Electricity	700, 2502	2	3	2	3
Mechanics	100, 2502	2		2	
Structure and Properties of Matter	2501, 2502	2		2	
Physical Education	3110	–	2	–	2
Practical Experience	10	–	–	–	–
Surveying (Division B only)	150, 151	1	3	–	–

Division C
Engineering Science

First Year Subjects Division C	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	602, 601	2	3	2	3
Engineering Problems and Drawing	142	–	6	–	6
English	2110	2	–	2	–
Mathematics:					
Algebra and Geometry	2415	2	–	2	–
Calculus	2416	2	–	2	–
Descriptive Geometry	135	1	–	1	–
Physics:					
Electricity	701	2	–	2	–
Statics	101	2	–	–	–
Properties of Matter; Mechanics and Heat	2511, 2512	3	4	3	4
Physical Education	3110	–	2	–	2

CIVIL ENGINEERING

(Course 1)

The course in Civil Engineering has been so designed as to be broad and comprehensive. It has been designed not only to meet the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire an engineering education of such a basic character as to enable them to enter various other fields of engineering employment.

In addition to instruction in engineering subjects, sufficient time is assigned to economic, legal and administrative studies to qualify the graduate in this course not only to engage in any of the branches of Civil Engineering but also to do administrative or executive work in industrial, commercial, government or other undertakings of an engineering character.

In the final year four options are offered:

A—Structural
B—Surveying
C—Municipal and Sanitary
D—Transportation and Soil Mechanics

Because of the common core of Civil Engineering material in the course, a graduate in any option will not be at a serious disadvantage

when engaged in engineering work that is more closely associated with one of the other options.

Most of the subjects in the Third Year are taken by all students, but, in addition to these common subjects, students proceeding to options A, C, and D in the Fourth Year must take the Group A subjects while those proceeding to option B must take the Group B subjects.

The subjects of instruction are shown in the following tables. In these tables numbers have been assigned to the subjects which refer to a more detailed description of each, e.g., Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	717, 718	2	1½	–	–
Applied Physics..............	721, 722	2	3	–	–
Calculus....................	2420	2	–	2	–
Dynamics....................	350	–	–	2	–
Economics...................	2720	2	–	2	–
Engineering Chemistry........	607	2	–	–	–
Engineering Geology.........	2906, 2907	2	1	1	2
Engineering Thermodynamics..	302	–	–	2	–
Engineering Problems and Drawing..............	138	–	6	–	6
Mechanics of Materials.......	105, 104	2	–	2	3
Physical Metallurgy..........	815	–	–	2	–
Practical Astronomy..........	157	–	–	2	–
Practical Experience..........	10	–	–	–	–
Surveying...................	153, 154	2	3	1	3

Each student in Civil Engineering is required to state, not later than June 29 following the completion of his Second Year, the group of subjects he desires to pursue in the Third Year. Permission to take either group of subjects must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Third Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Fluid Mechanics	333, 334	2	–	2	3
Highway Engineering I	185, 195	2	1½	–	–
Engineering Mathematics	141, 139	2	1½	2	3
Municipal Planning, Administration and Transportation	186	–	–	3	–
Practical Experience	10	–	–	–	–
Sanitary Engineering	180	2	–	–	–
Soil Mechanics	191, 195	2	1½	–	–
Survey Camp	158	–	–	–	–
One of					
Modern World History	2330	2	–	2	–
Political Science	2730				
And either of the following groups of subjects:					
Group A (Leading to options 1A, 1C and 1D)					
Mechanics of Materials II	110, 113	2	7½	2	
Structural Design I	111, 113	2		2	6
Structural Theory I	112, 113	–		3	
Group B (Leading to option 1B)					
Geodetic Engineering	160, 161	–	–	2	3
Least Squares	159	–	–	–	3
Optics and Photogrammetry	162, 163	2	3	–	–
Photo Interpretation	164, 165	–	–	2	3
Structural Engineering I	114, 115	2	1½	2	3

Civil Engineering students selecting the Group A subjects are required to state not later than June 29 following the completion of their Third Year the options (one of options 1A, 1C or 1D) they desire to pursue in the Fourth Year. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Civil Engineering students selecting the Group B subjects in their Third Year, must pursue option 1B in their Fourth Year.

Fourth Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Construction Management and Business	130	–	–	2	–
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
And one of the following options:					
Option 1A (Structural)					
Behaviour and Design of Steel Structures	118	2	–	2	–
Hydraulic Engineering	343	–	–	3	–
Mathematical Applications	140	2	–	–	–
Reinforced Concrete I	116	2	–	2	–
Reinforced Concrete II	117	2	–	2	–
Soil Mechanics and Foundations	192, 196	2	–	1	2
Structural Theory II	119	2	–	3	–
Thesis Project, Laboratory and Seminar	20, 120	–	12	–	10
Option 1B (Surveying)					
Adjustment of Observations and Computer Programming	168, 169	–	3	2	3
Advanced Photogrammetry	170, 171	2	4½	–	–
Astronomy	172, 173	1	3	–	–
Electronics	743, 744	–	–	2	1½
Engineering and Legal Surveys	174	2	–	1	–
Geodesy	175, 176	1	–	1	3
Hydraulic Engineering	343	–	–	3	–
Structural Engineering II	122, 123	2	4½	2	3
Survey Camp	167	–	–	–	–
Town and Regional Planning	3540, 3541	1	3	1	3
Thesis	20	–	–	–	1

FOURTH YEAR SUBJECTS COURSE 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
OPTION 1C (Municipal and Sanitary)					
Air and Water Resources	181	2	–	3	–
Highway Engineering II	187	–	–	2	–
Hydraulic Engineering	341, 342	2	$1\frac{1}{2}$	2	3
Mathematical Applications	140	2	–	–	–
Municipal Engineering and Planning	182	2	–	2	–
Reinforced Concrete I	116, 121	2	3	2	3
Soil Mechanics and Foundations	192, 196	2	–	1	2
Thesis Project, Laboratory and Seminar	20, 183	–	$7\frac{1}{2}$	–	7
OPTION 1D (Transportation and Soil Mechanics)					
Air Photo Interpretation	189, 197	1	3	–	–
Highway Engineering II	187	–	–	2	–
Hydraulic Engineering	343	–	–	3	–
Mathematical Applications	140	2	–	–	–
Pleistocene Geology	2936	2	–	2	–
Reinforced Concrete I	116, 121	2	3	2	3
Soil Mechanics and Foundations	192, 196	2	–	1	2
Transportation Engineering *or* Earth Structures and Foundations	188 / 193	3	–	3	–
Thesis Project, Laboratory and Seminar	20, 198	–	6	–	7

MINING ENGINEERING

(Course 2)

The Mining Engineer is concerned with all aspects of the winning of metals and minerals from their geological environments in the earth's crust, and of their conversion to forms in which they can best be utilized in the growing needs and comforts of man. Thus, the course in Mining Engineering has been designed to prepare its graduates for successful participation in the engineering, operational, and administrative activities of those aspects.

The professional fields concerned include mineral exploration, evaluation and development of mineral properties, the mining of ores from a multiplicity of geological situations by the most advanced methods, the treatment of ores in beneficiating and metallurgical plants, and the economics of mineral markets. For the enhancement of abilities in supervision and management, the administrative viewpoint and attitude are stressed in the professional subjects during the later years of the course.

Building upon a foundation in the disciplines of mathematics, physics, and chemistry, the student proceeds through training in geology, mechanics, electricity, economics, business, and general engineering subjects, to a growing proportion of specifics dealing with the fields which the course is designed to serve. The diversification of this training renders the Mining Engineer capable of successful participation in all branches of industry and commerce.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

Second Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
A. C. Circuits I	717, 718	2	1½	–	–
Analytical Chemistry Laboratory	606	–	6	–	–
Calculus	2420, 144	2	1½	2	1½
Chemistry	605	2	–	–	–
Economics	2720	2	–	2	–
Historical and Stratigraphic Geology	2930	–	–	2	1
Mechanics of Materials	102, 104	2	–	2	3
Mineralogy and Lithology	2910, 2911	2	2	2	2

Second Year Subjects Course 2—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Mining	221	1	–	1	2
Oral Expression	271	–	–	–	2
Physical Geology	2900, 2901	2	3	–	–
Practical Experience	10	–	–	–	–
Surveying	155, 156	1	3	2	2

Third Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	201, 202	1	3	1	3
Elementary Structural Engineering	124, 125	1	–	2	3
Fluid Flow and Pumping Systems	335, 336	3	3	–	–
Geological Field Work	2983	–	–	–	–
Engineering Thermodynamics	306, 307	1	–	1	3
Metallurgy	804	–	–	1	–
Mineral Dressing	241, 243	2	–	2	6
Mining	222	1	–	2	–
Mining Laboratory	223	–	3	–	2
Operations Research	412, 413	2	$1\frac{1}{2}$	–	–
Practical Experience	10	–	–	–	–
Structural Geology	2950, 2951	1	3	1	3
Summer Essays	261	–	2	–	–
Survey Camp	158	–	–	–	–
Wet Analysis	203	–	3	–	3
And one of:					
Modern World History / Political Science	2330 / 2730	2	–	2	–

Fourth Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	2140	1	–	1	–
Glacial Geology and Ground Water	2934, 2985	1	–	1	–
Machine Design	371, 372	1	–	1	3
Metallurgy	808, 809	1	–	1	3
Mine Operation and Administration	224, 225	2	2	2	6
Mineral Deposits	2960	2	–	2	–
Mine Ventilation	321, 251	2	3	–	–
Mining Geology	2968	–	–	2	–
Ore Dressing	244, 245	1	6	1	–
Physical Metallurgy	815	–	–	2	–
Practical Experience	10	–	–	–	–
Precambrian Geology	2944, 2945	2	1	–	–
Philosophy of Science	2040	2	–	–	–
Thesis Project, Laboratory, and Seminar	20, 275	–	$5\frac{1}{2}$	–	6

MECHANICAL ENGINEERING

(Course 3)

Traditionally associated with the art and science of power generation and the machinery whereby power is usefully applied, Mechanical Engineering, like other branches of the engineering profession, participates in the rapid advance of scientific knowledge and interprets it in the design and development of practical systems.

The curriculum is based on a broad foundation of mathematics and the fundamental physical sciences and includes a sufficient variety of topics to provide a balanced and challenging professional programme. Current engineering practice in its many aspects is considered while specific attention is directed toward developing the student in the analytical and scientific approach.

While the interests of the mechanical engineer encompass a very wide range of professional activity, his special skills most often lead him into design, development, or management. Representative fields of occupation include: design of mechanisms and machines, precision measurement, vibration analysis, hydraulic systems, materials handling, power generation, aircraft and spacecraft propulsion, refrigeration, heating, ventilating and air conditioning, controls and automation, pumps and compressors, pulp and paper production, gas and oil pipelines.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	717, 718	–	–	2	1½
Calculus....................	2420	2	–	2	–
Dynamics of Machines........	357	3	–	3	–
Economics..................	2720	2	–	2	–
Electricity..................	714, 713	2	3	–	–
Engineering Chemistry........	607	2	–	–	–
Heat Engineering, Elementary.	303	–	–	2	–
Machine Design..............	356, 358	–	6	2	6
Mathematical Analysis........	383	–	1½	–	1½
Mechanical Engineering.......	355	1	–	–	–
Mechanics of Materials I.....	105, 104	2	3	2	–
Physical Metallurgy..........	817, 818	2	–	2	1½
Practical Experience..........	10	–	–	–	–

Third Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Equations........	2432	2	–	2	–
Electronics..................	743, 744	2	1½	–	–
Electric Machines............	747, 748	2	1½	2	3
Engineering Analysis..........	386	–	1½	–	3
Engineering Thermodynamics..	309, 310	2	3	2	3
Fluid Mechanics.............	333, 334	2	–	2	3
Heat Engineering.............	308	2	–	1	–
Machine Design..............	363, 364	2	6	–	3
Practical Experience..........	10	–	–	–	–
Treatment of Technical Data..	387	–	–	2	3
And one of:					
Modern World History........	2330 }	2	–	2	–
Political Science.............	2730 }				

Fourth Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Engineering	390	1	3	2	3
Elements of Control Theory	391, 392	2	3	–	–
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Heat Power Engineering	323, 324	2	3	2	4½
Hydraulics	344, 345	2	3	2	4½
Industrial Management	396	1	–	–	–
Internal Combustion	322	1	–	1	–
Machine Design	373, 374	2	3	2	4½
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Structural Engineering	126, 127	–	–	2	3
Thesis	20	–	1	–	1

INDUSTRIAL ENGINEERING

(Course 4)

The modern view of Industrial Engineering is that of a field concerned essentially with the analysis, design, improvement and operation of integrated systems of men, materials and equipment. This new concept crystallized when it became clear that certain modern technical fields, including operational research, control theory, computer science, and probability and statistics, constituted a body of knowledge particularly useful in the operation and management of modern business, industry and government.

As a logical outcome of this development, the course in Industrial Engineering was established in 1958 to provide graduates in engineering specializing in the theory and practice of these subjects. This specialization rests upon a substantial foundation in science and mathematics, in fundamental engineering disciplines including fluid mechanics, applied thermodynamics, electrical science, mechanics of materials and machine design, and in such subjects as economics, organizational structure, financial control and industrial psychology.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	717, 718	–	–	2	1½
Calculus....................	2420	2	–	2	–
Dynamics....................	350	–	–	2	–
Economics..................	2720	2	–	2	–
Electricity..................	714, 713	2	3	–	–
Engineering Chemistry........	607	2	–	–	–
Mathematical Analysis........	383	–	1½	–	1½
Mechanical Design............	359, 360	1	6	1	6
Mechanics of Materials.......	102, 104	2	3	2	–
Practical Experience..........	10	–	–	–	–
Probability and Statistics.....	2423, 2424	2	2	2	2
Physical Metallurgy..........	817, 818	2	–	2	1½

Third Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Accounting	2734	2	–	2	–
Differential Equations	2432	2	–	2	–
Electronics	743, 744	2	$1\frac{1}{2}$	–	–
Elementary Structural Engineering	124, 125	1	–	2	3
Engineering Data Processing	3331, 3332	–	–	2	3
Fluid Mechanics	337, 338	2	3	–	–
Engineering Thermodynamics	311, 312	2	3	–	–
Industrial Management	3030, 3031	2	3	2	3
Numerical Analysis	2433, 2434	2	3	2	3
Practical Experience	10	–	–	–	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Current Developments in Industrial Engineering	409, 410	–	–	2	2
Dynamics of Industrial Systems	405, 406	2	3	–	–
Elementary Control Theory	407, 408	2	3	2	3
Electric Machines	760, 761	2	3	–	–
Engineering Data Processing	3331, 3332	–	–	2	3
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Industrial Engineering Seminar	411	–	–	–	3
Industrial Psychology (commencing 1964–65)	2840	–	–	2	–
Machine Design	375, 376	2	3	2	3
Operations Research I	401, 402	2	3	2	3
Operations Research II	403, 404	–	–	2	3
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Thesis	20	–	2	–	2

ENGINEERING SCIENCE

(ENGINEERING PHYSICS)

(COURSE 5)

The Course in "Engineering Physics" was established in 1934 "to afford a training in mathematics and physics beyond that which it is possible to give in the other undergraduate courses in engineering". Originally the options offered in the Third and Fouth Years were related to the physical sciences and the name of the course, Engineering Physics, was appropriate.

In 1958 a Chemical Option was added on the same basis, i.e. in Third and Fourth Years.

Commencing in the session 1962–63 the scope of the course is to be broadened to include, more adequately than in the past, an option (or options) related to the chemical sciences. The name of the course therefore is to be changed to "Engineering Science" commencing with the class graduating in 1965.

The purpose of the course is not changed. It is designed for those, who, having a definite flair for mathematics and science, anticipate proceeding to post-graduate study and an occupation in the fields of research and development or teaching.

In the Second Year the student may select one of two programmes, differing by about 4 hours per week, which provide slightly greater emphasis either on the physical or the chemical sciences.

The options offered in the Third and Fourth Years cater to a variety of specific interests and prepare the student for post-graduate work in many of the Engineering Departments or in Physics, Biophysics or Applied Mathematics.

Admission to this course is granted only to those students who, having met the general admission requirements set forth on page 20 of this Calendar, obtain an average of 70% on the nine specified papers of Grade XIII, or the equivalent in other school systems.

Promotion to the Second Year of the Engineering Science course is granted only to those students who, in addition to meeting the regular requirements, obtain a weighted average of not less than 66% on the examinations of the First Year. Students who obtain a weighted average of 60% or over in the First Year of this course, and who have met all the regular requirements, will be permitted to proceed to the Second Year of any course in the Faculty, other than Engineering Science, without condition. Permission to repeat the First Year of the course in Engineering Science must be sought by petition to the Council of the Faculty.

The subjects of instruction are shown in the following tables and are more fully described according to subject reference numbers, page 64 to 128.

For FIRST YEAR CURRICULUM—DIVISION C, see page 33.

Students are required to state at the beginning of the Second Year which elective they intend to choose, and at the beginning of the Third Year which option they intend to pursue. Council retains the right to withhold an option if the number of students offering or conditions existing at the time render it impracticable to give the work.

Second Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Calculus	2425	2	–	2	–
Economics	2720	2	–	2	–
Electric Circuits	715, 716	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Integral Calculus	2426	2	–	2	–
Mathematical Problems	2428	–	3	–	3
Physical Chemistry	608, 609	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Physics	2521, 2522	3	3	3	3
Probability and Numerical Methods	2427	2	–	2	–
*And either of the following groups of subjects:**					
Dynamics	351	2	–	–	–
Mechanics of Materials	103, 104	–	–	2	3
or					
Inorganic Chemistry	2621	2	–	2	–
Chemical Engineering Science Laboratory	610	–	–	–	3

*It should be noted that Dynamics and Mechanics of Materials are desirable preliminary subjects for those taking Advanced Mechanics, Mechanics of Solids and Structures, or Machine Design, in the Third Year.

Third Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5a, Aeronautics/ Astronautics					
Advanced Mechanics	1030	2	–	2	–
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	1½
Mechanics of Solids and Structures	1034, 1035	2	3	2	3
Fluid Mechanics	1032, 1033	2	3	2	3
Physical Metallurgy	816	1	–	1	–
Physics Laboratory	2532	–	3	–	3
Thermodynamics and Kinetic Theory	2531	2	–	2	–
Theory of Functions	2437	1	1	1	1
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5c, Chemical					
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	1½
Atomic and Molecular Structure	2631	2	–	2	–
Chem. Eng. Thermodynamics	640	2	–	2	–
Chem. Eng. Rate Processes	641	3	–	3	–
Fluid Mechanics	1032, 1033	2	3	2	3
Chem. Eng. Problems and Lab.	642	–	9	–	9
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5e, Electrical					
Advanced Mechanics	1030	2	–	2	–
Atomic Structure and Quantum Physics	2533	2	–	2	–
Circuit Analysis	742	2	–	2	–
Differential Equations	2438	2	–	2	–
Electronics	739, 738	2	–	2	3
Physical Metallurgy	819, 820	–	–	2	1½
Physics Laboratory	2532	–	3	–	3
Physics of Solids and Fluids	2534	2	–	–	–
Thermodynamics and Kinetic Theory	2531	2	–	2	–
Theory of Functions	2437	1	1	1	1

THIRD YEAR SUBJECTS COURSE 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
And one of:					
Modern World History........	2330	2	–	2	–
Political Science..............	2730				
Option 5g, Geophysics					
Advanced Mechanics.........	1030	2	–	2	–
Differential Equations........	2438	2	–	2	–
Electronics..................	740, 741	2	–	2	1½
Mineralogy and Lithology.....	2910, 2911	2	2	2	2
Physical Geology.............	2902, 2901	–	3	–	–
Physics Laboratory...........	2532	–	3	–	3
Physical Metallurgy..........	816	1	–	1	–
Physics of Solids and Fluids...	2534	2	–	–	–
Physics of the Earth..........	2536	1	–	1	–
Structural Geology...........	2950, 2951	1	3	1	3
Thermodynamics and Kinetic Theory....................	2531	2	–	2	–
Theory of Functions..........	2437	1	1	1	1
And one of:					
Modern World History........	2330	2	–	2	–
Political Science..............	2730				
Option 5m, Physical Metallurgy					
Advanced Mechanics.........	1030	2	–	2	–
Crystallography..............	2916	1	–	1	–
Differential Equations........	2438	2	–	2	–
Electronics..................	739, 738	2	–	2	3
Machine Design..............	365, 366	1	3	1	3
Physical Metallurgy..........	821, 822	2	3	2	3
Physics Laboratory...........	2532	–	3	–	3
Physics of Solids and Fluids...	2534	2	–	–	–
Thermodynamics and Kinetic Theory....................	2531	2	–	2	–
Theory of Functions..........	2437	1	1	1	1
And one of:					
Modern World History........	2330	2	–	2	–
Political Science..............	2730				
Option 5n, Nuclear					
Advanced Mechanics.........	1030	2	–	2	–
Atomic Structure and Quantum Physics..................	2533	2	–	2	–
Differential Equations........	2438	2	–	2	–
Electronics..................	740, 741	2	–	2	1½

Third Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Fluid Mechanics	1032, 1033	2	3	2	3
Machine Design	365, 366	1	3	1	3
Nuclear Physics	2535	1	–	1	–
Physics Laboratory	2532	–	3	–	3
Thermodynamics and Kinetic Theory	2531	2	–	2	–
Theory of Functions	2437	1	1	1	1
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5p, Physics					
Advanced Mechanics	1030	2	–	2	–
Atomic Structure and Quantum Physics	2533	2	–	2	–
Crystallography	2916	1	–	1	–
Differential Equations	2438	2	–	2	–
Electronics	739, 738	2	–	2	3
Machine Design	365, 366	1	3	1	3
Physics Laboratory	2532	–	3	–	3
Physics of Solids and Fluids	2534	2	–	–	–
Thermodynamics and Kinetic Theory	2531	2	–	2	–
Theory of Functions	2437	1	1	1	1
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5t, Thermodynamics					
Advanced Mechanics	1030	2	–	2	–
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	$1\frac{1}{2}$
Fluid Mechanics	1032, 1033	2	3	2	3
Heat Engineering	313, 314	2	3	2	3
Machine Design	365, 366	1	3	1	3
Physical Metallurgy	816	1	–	1	–
Physics Laboratory	2532	–	3	–	3
Thermodynamics and Kinetic Theory	2531	2	–	2	–
Theory of Functions	2437	1	1	1	1
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5a, Aeronautics/ Astronautics					
Aerodynamics	1040, 1041	2	–	2	3
Atomic Physics	2546	3	–	3	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
Engineering Design	1042, 1043	1	3	2	3
English	2140	1	–	1	–
Gasdynamics	1048, 1049	2	1½	1	3
Mechanics of Solids and Structures	1044, 1045	1	3	1	–
Philosophy of Science	2040	2	–	–	–
Plasmadynamics	1046, 1047	1	–	2	1½
Thesis	20	–	–	–	–
Transport Phenomena	1050	1	–	1	–
Option 5c, Chemical					
Atomic Physics	2546	3	–	3	–
Chem. Eng. Laboratory	662	–	6	–	9
Chem. Eng. Thermodynamics and Kinetics	655	2	–	2	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
Mass Transfer Operations	650	2	–	2	–
English	2140	1	–	1	–
Organic Chemistry	660, 661	2	3	2	–
Philosophy of Science	2040	2	–	–	–
Physics Laboratory	2542	–	6	–	6
Thesis	20	–	–	–	–
Option 5e, Electrical					
Atomic Physics	2546	3	–	3	–
Electronic Circuits	768, 769	3	3	–	–
Communication Systems	770, 771	–	–	3	3
Microwave Engineering	776	–	–	2	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
Control Systems	766, 767	2	1½	2	1½
English	2140	1	–	1	–
Electromagnetic Theory, Applied	773	2	–	2	–
Operational Methods	772	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Thesis	20	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5g, Geophysics					
Atomic Physics	2546	3	–	3	
Differential Equations of Mathematical Physics	521	2	–	2	–
Electromagnetic Theory, Applied	773	2	–	2	–
English	2140	1	–	1	–
Geophysical Methods	2561, 2562	2	6	2	6
Mineral Deposits	2960	2	–	2	–
Petroleum Geology	2964, 2965	2	–	2	3
Philosophy of Science	2040	2	–	–	–
Physics of the Earth	2563	–	–	2	–
Precambrian Geology	2944, 2945	2	1	–	–
Thesis	20	–	–	–	–
Option 5m, Physical Metallurgy					
Atomic Physics	2546	3	–	3	–
Electronic Circuits	768, 769	3	3	–	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
English	2140	1	–	1	–
Metal Physics Seminar	826	–	3	–	3
Metal Physics Laboratory	827	–	6	–	12
Operational Methods	772	2	–	2	–
Physical Metallurgy	823, 825	2	3	2	3
Philosophy of Science	2040	2	–	–	–
Thesis	20	–	–	–	–
X-Ray Crystallography	2918	–	–	2	–
Option 5n, Nuclear					
Differential Equations of Mathematical Physics	2445	2	–	2	–
Control Systems	766, 767	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Electromagnetic Theory, Applied	773	2	–	2	–
English	2140	1	–	1	–
Heat Transfer	328	–	–	2	–
Nuclear and High Energy Physics	2544	2	–	2	–
Nuclear Engineering	670	2	3	2	3
Operational Methods	772	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Physical Metallurgy	816	1	–	1	–
Physics Laboratory	2542	–	6	–	3
Thesis	20	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5p, Physics					
Electronic Circuits	768, 769	3	3	–	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
Electromagnetic Radiation and Matter	2541	2	–	2	–
Electromagnetic Theory, Applied	773	2	–	2	–
English	2140	1	–	1	–
Molecular Physics and Statistical Mechanics	2543	2	–	2	–
Nuclear and High Energy Physics	2544	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Physics Laboratory	2542	–	6	–	6
Quantum Mechanics	2545	2	–	2	–
Thesis	20	–	–	–	–
Option 5t, Thermodynamics					
Atomic Physics	2546	3	–	3	–
Computational Methods	393	1	3	–	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
English	2140	1	–	1	–
Gasdynamics	13, 16	2	1½	1	3
Heat Engineering Laboratory	329	–	3	–	3
Heat Power Engineering	326	1	–	1	–
Heat Transfer	328	–	–	2	–
Refrigeration and Air Conditioning	325	2	–	–	–
Internal Combustion	327	1	–	1	–
Machine Design	377	–	–	2	–
Operational Methods	772	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Thesis	20	–	–	–	–
Vibration Engineering	798, 799	1	–	1	3

CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(Course 6)

The chemical engineer is concerned with the development and operation of processes by means of which matter is chemically altered to a more useful form, and in the design, construction, operation and management of plant in which to effect such changes. Apart from such obviously chemical processes as those concerned with the production of acids, alkalis, salts, petroleum, rubber products, pulp and paper, explosives, paints and varnishes, soap, plastics, etc., there are many industrial processes where chemistry plays a part, or where a knowledge of chemistry is valuable. There is thus a wide field of endeavour for the chemical engineer. In order to equip a student to enter this field, the course in chemical engineering is intended to provide the student with training in the principles of the major divisions of chemistry and chemical engineering, together with an understanding of such other engineering subjects as thermodynamics, hydraulics, electricity, mechanics of materials, and machine design.

As part of the work of the Fourth Year each student is assigned a problem involving original investigation, in order to let him apply to some extent what he has learned, and to introduce him to the chemical literature. It also serves as an introduction to research for those who are attracted to it, and who, because of their basic training are equipped to carry on research in chemistry or chemical engineering at the graduate level or in laboratories outside the university.

For those students considering taking up the teaching of science as a profession, the nature and extent of the thesis subject in the Fourth Year may be modified to allow the student to take such other instruction as may be necessary to shorten the time required before becoming professionally qualified.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description, *e.g.*, Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	615, 614	2	9	–	–
Analytical Chemistry Laboratory	613	–	–	–	–
Calculus	2420, 144	2	1½	2	1½
Chemical Engineering Science Laboratory	619	–	–	–	9
Economics	2720	2	–	2	–
Electrical Engineering	719, 720	2	3	2	3
Industrial Chemistry	616	2	–	1	–
Inorganic Chemistry	617	1	–	2	–
Mechanics of Materials	102	2	–	2	–
Organic Chemistry	618	1	–	2	–
Physical Chemistry	2622	2	–	2	–
Practical Experience	10	–	–	–	–

Third Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemical Laboratory	627	–	6	–	6
Chemical Theory A	625	1	–	1	–
Chemical Theory B	626	2	–	2	–
Differential Equations	2430	1	–	1	–
Fluid Mechanics	337, 338	2	3	–	–
Engineering Thermodynamics	315, 316	2	–	–	3
Industrial Chemistry	630	–	–	3	–
Introduction to Mass and Heat Transfer	631	2	–	2	3
Organic Chemistry	628, 629	2	9	2	6
Practical Experience	10	–	–	–	–
Public Speaking	632	–	1	–	1
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Chemical Engineering	653	–	3	–	–
Chemical Engineering Thermodynamics and Kinetics	655	2	–	2	–
Chemical Engineering Laboratory	652	–	9	–	–
Chemical Plant Design	651	1	–	–	3
Electrochemistry	2632, 2633	2	1½	–	–
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Industrial Management	396	1	–	–	–
Machine Design	378, 379	2	–	1	3
Mass Transfer Operations	650	2	–	2	–
Organic Chemistry	654	1	–	1	–
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Thesis	20	–	3	–	18

ELECTRICAL ENGINEERING

(Course 7)

In following his profession, an electrical engineer will find necessary a knowledge of many fields in addition to that of applying things electrical for the benefit of humanity. For this reason the course includes not only mathematics, mechanics, physics and chemistry, but also heat engines, hvdraulics, theory of mechanisms, machine design, business, economics, engineering law, and other non-electrical subjects.

In the electrical field much time is given to the calculation of circuits of electric, magnetic, and dielectric types, methods of measurement of various quantities in direct and alternating current circuits, theory of generators, motors, magnets, and other apparatus, design, electrical transmission of energy, and many related matters of interest. A great variety of problems for solution is one means of developing understanding. In the Fourth Year the proportion of time given to electrical engineering is much greater than in earlier years.

A training of this nature should, with subsequent experience, enable a student to develop into a useful and valued member of the profession, whether his natural abilities lead him into technical, commercial, or administrative responsibilities.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description, *e.g.*, Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Physics	721, 722	–	–	2	3
Chemistry	2623	2	–	–	–
Calculus and Differential Equations	2421	2	2	2	2
Dynamics	352, 353	2	1½	1	1½
Economics	2720	2	–	2	–
Electric Circuits I	710	3	2	3	2
Electric and Magnetic Fields	711	2		2	
Electrical Measurements	712	–	–	2	–
Electrical Laboratory	713	–	3	–	3
Mechanics of Materials	106, 104	2	3	1	–
Practical Experience	10	–	–	–	–

THIRD YEAR SUBJECTS COURSE 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics	732	2	2	2	2
Electric Circuits II	733	3	–	3	–
Electric Machinery I	734	2	–	1	–
Electronics	737	2	–	3	–
Electrical Problems	736	–	4	–	4
Electrical Laboratory	735	–	3	–	3
Electronics Laboratory	738	–	–	–	3
Heat Engineering Laboratory	318	–	3	–	–
Machine Design	367, 368	2	3	–	–
Physical Metallurgy	819, 820	–	–	2	1½
Practical Experience	10	–	–	–	–
Thermodynamics	317	2	–	1	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Electronic Circuits	768, 769	3	3	–	–
Electric Machinery II	763, 764	3	3	–	–
Control Systems	765, 767	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Electromagnetic Engineering	762	2	1	2	1
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Fluid Mechanics	346, 347	1	–	2	3
Industrial Management	396	1	–	–	–
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Thesis	20	–	1	–	1
And one subject from each of Groups A, B, and C.					
Group A					
Communication Systems	770, 771	–	–	3	3
Electric Power Systems	779, 780	–	–	3	3
Group B					
Microwave Engineering	776, 777	–	–	2	$1\frac{1}{2}$
Electric Machinery III	774, 775	–	–	2	$1\frac{1}{2}$
Group C					
Acoustics	792, 793	–	–	2	$1\frac{1}{2}$
Illumination	794, 795	–	–	2	$1\frac{1}{2}$

METALLURGICAL ENGINEERING

(Course 8)

No other materials approach the metals in strength, and the whole fabric of modern civilization is dependent on their properties. The fields of employment for graduates lie in production metallurgical industries, the industries which fabricate metals, and in sales and research. Metallurgical research facilities have notably been increased in recent years in Canada.

The metallurgical engineer is concerned with the winning of metals from ores. Since virgin metals rarely possess useful physical properties,

the second task of the metallurgist is to produce alloys, such as steel, which have suitable physical properties.

Both physical and extractive metallurgy are based upon the sciences of chemistry and physics. It is believed that a wider knowledge of the basic sciences will bring to the student a readier appreciation of the technical problems with which he will be later confronted and a greater facility in their solution. To achieve this end, greater emphasis is placed upon physics and chemistry in the earlier years of the course. It follows that this course will be of greater value to students who have obtained a good standing in mathematics and science. In addition to instruction in extractive and physical metallurgy, engineering subjects are provided to give a general knowledge of mechanics of materials, machine design, etc. The course includes the non-technical subjects, such as Economics and English, which are common to all courses in the Faculty.

Courses in production metallurgy cover the theory and practice of winning aluminium, copper, iron, lead, magnesium, nickel, zinc, etc., from their ores. Physical Metallurgy courses cover the structure and properties of alloys, including microscopic, x-rays and mechanical methods of investigation.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description, *e.g.*, Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION A, see page 32.

Second Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	2624	–	4	–	4
Calculus	2420	2	–	2	–
Economics	2720	2	–	2	–
Electrical Engineering	719, 720	2	3	2	3
Engineering Problems and Drawing	143	–	3	–	3
Inorganic Chemistry	617	1	–	2	–
Mechanics of Materials	102, 104	2	3	2	–
Metallurgy	801	2	–	2	–
Metallurgy Problems	811	–	–	–	2
Optics	723, 724	1	3	1	3
Physical Chemistry	2622	2	–	2	–
Practical Experience	10	–	–	–	–

Third Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	201, 204	1	3	1	–
Crystallography	2916	1	–	1	–
Differential Equations	2430	1	–	1	–
Fluid Mechanics	337	2	–	–	–
Metallurgical Problems Laboratory	812	–	4	–	4
Metallurgical Thermodynamics I	810	2	–	2	–
Mineral Dressing	241, 242	2	–	2	6
Practical Experience	10	–	–	–	–
Principles of Extractive Metallurgy	802, 803	2	3	2	6
Principles of Physical Metallurgy	821, 822	2	3	2	3
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Electrochemistry	2632, 2633	2	$1\frac{1}{2}$	–	–
English	2140	1	–	1	–
Extractive Metallurgy Laboratory	806	–	6	–	–
Ferrous Extractive Metallurgy	807	1	–	1	–
Fluid Mechanics	337	2	–	–	–
Heat Transfer	330	–	–	2	–
Machine Design	371, 372	1	–	1	3
Metallurgical Thermodynamics II	813	2	–	2	–
Metallurgical Problems Laboratory	814	–	2	–	2
Non-Ferrous Extractive Metallurgy	805	1	–	1	–
Ore Dressing	244	1	–	1	–
Philosophy of Science	2040	2	–	–	–
Physical Metallurgy	823, 824	2	6	2	3
Practical Experience	10	–	–	–	–
Statistics	2442	–	–	2	–
Thesis	20	–	3	–	12

APPLIED GEOLOGY

(Course 9)

The expanding Canadian economy is making ever growing demands on the Mineral Industry for raw products—iron, copper, uranium, gas, petroleum, etc. Geologists play an important part in this industry. They belong to a team—whose other members are mining engineers and metallurgists—responsible for finding new deposits of metals, mining them, and extracting the metals from the ores. In addition, geologists are widely employed in the petroleum industry.

The course in Applied Geology provides a training in the fundamentals of the geological sciences and graduates in this course are suitably trained to enter the ranks of professional geologists. Students also take work with related departments, such as Mining Engineering, Metallurgical Engineering, Chemical Engineering and Civil Engineering, and in this way have some knowledge of other fields of engineering.

The geological subjects are selected so that they will carry the student through from an introductory course to a stage where he has a useful knowledge of the broad field of the subject. He is properly trained to find employment in mining geology, petroleum geology, or engineering geology. Such work may be with exploration companies, oil companies or mining companies.

Graduates in Applied Geology who wish further specialized training in geology may proceed to the M.A.Sc. or Ph.D. degrees, and thus qualify themselves for employment with government geological surveys or as university teachers.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description, *e.g.*, Economics, 2720, page 122.

For FIRST YEAR CURRICULUM—DIVISION B, see page 32.

SECOND YEAR SUBJECTS COURSE 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	606	–	6	–	–
Calculus	2420, 144	2	1½	2	1½
Chemistry	605	2	–	–	–
Economics	2720	2	–	2	–
Historical and Stratigraphical Geology	2930, 2931	–	–	2	3
Mechanics of Materials	102, 104	2	–	2	3
Mineralogy and Lithology	2910, 2911	2	2	2	2
Mining	221	1	–	1	2
Optics	723, 724	1	3	1	3
Oral Expression	271	–	–	–	2
Physical Geology	2900, 2901	2	3	–	–
Practical Experience	10	–	–	–	–
Surveying	155, 156	1	3	2	2

THIRD YEAR SUBJECTS COURSE 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	201, 202	1	3	1	3
Descriptive Mineralogy	2913	–	2	–	2
Elementary Geochemistry	2924	2	–	2	–
Geological Field Work	2983	–	–	–	–
Metallurgy	804	–	–	1	–
Mineral Dressing	246	2	–	–	–
Mining	222	1	–	2	–
Ore Microscopy	2915	–	–	–	3
Palaeontology	2938, 2939	2	2	2	2
Petrology	2920, 2921	3	2	2	2
Practical Experience	10	–	–	–	–
Stratigraphy and Sedimentation	2932, 2981	2	2	–	–
Structural Geology	2950, 2951	1	3	1	3
Survey Camp	158	–	–	–	–
And one of:					
Modern World History / Political Science	2330 / 2730	2	–	2	–

Fourth Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	2140	1	–	1	–
Geology of Canada	2904	1	–	1	–
Geological Field Trips	2985, 2987	–	–	–	–
Geophysics	2568, 2569	1	3	1	3
Metallurgy	808	1	–	1	–
Mineral Deposits	2960, 2961	2	–	2	3
Mine Operation and Administration	224, 226	2	–	2	3
Mining Geology	2968, 2969	–	3	2	–
Petroleum Geology	2964, 2965	2	–	2	3
Pleistocene Geology	2936	2	–	2	–
Practical Experience	10	–	–	–	–
Precambrian Geology	2944, 2945	2	3	–	3
Philosophy of Science	2040	2	–	–	–
Thesis	20	–	6	–	–

AERONAUTICAL/ASTRONAUTICAL ENGINEERING

A five year program of study has been designed to prepare the student for a career in aeronautical/astronautical engineering. It includes the following elements: (a) an introduction to the fundamentals of mathematics, physics, and chemistry, (b) an introduction to aerodynamics, instrumentation, propulsion, structures and design, and (c) an advanced treatment of the subjects required for modern design and research in aeronautics/astronautics such as hypersonic aerodynamics, flight dynamics, and space propulsion. Under (a) and (b) the student's training is necessarily broad and basic. The more advanced knowledge needed for the research, development, and design relevant to new aircraft and spacecraft is provided under (c) and is of particular significance. It is possible to provide (a) and (b) in a four-year undergraduate course, but the final intensive training under (c) must be left for a graduate year.

The program of study that leads to status as a well-qualified aeronautical/astronautical engineer has been established in two parts as follows:

(i) *Undergraduate Course.* The student registers in the course in Engineering Science, subject to the entrance requirements given on page 20 of this Calendar. This course provides the requisite training in the

fundamental sciences (see (*a*) above). The advanced subjects contained in the Aeronautics/Astronautics option given in the third and fourth years are taught by the staff of the Institute of Aerophysics (see (*b*) above). The student will receive the degree of Bachelor of Applied Science upon completion of this part of the program.

(ii) *Graduate Course.* The student will then continue his five year program (*see* (*c*) above) in the Department of Aeronautical Engineering and Aerophysics, School of Graduate Studies, as a candidate for the degree of Master of Applied Science in Aeronautical/Astronautical Engineering. Details regarding entrance regulations and courses of study are given in the Calendar of the School of Graduate Studies. The facilities of the Institute of Aerophysics are available to the student. For details of research projects, assistantships, scholarships and demonstratorships, students should consult the Director of the Institute of Aerophysics.

It should be noted that a student who has graduated in another branch of engineering and who desires to qualify as an aeronautical/astronautical engineer may proceed directly with (ii) above, but in this case the course leading to the M.A.Sc. degree must be arranged so that deficiencies in his undergraduate training are made up.

The facilities of the Institute of Aerophysics are available for further graduate study leading to the Ph.D. Degree.

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 135, Descriptive Geometry, means the course of lecures indicated by this number in the table of curriculum for the First Year on page 32.

Where laboratory reports are to be written outside of assigned laboratory hours the maximum number of such reports is indicated in the description of the laboratory course concerned.

FACULTY REQUIREMENTS

10. Practical Experience.

Students in the courses listed below are required to have, before graduation, practical work of a nature acceptable to the department concerned. This may be obtained during the summer vacations but work done before entering the Faculty may also meet the requirements. Instructions will be issued by the departments concerning the type of work which is acceptable. Practical experience certificate forms may be obtained from the departments and should be returned there when completed.

Course 1	600 hours
Course 2	800 hours
Course 3	600 hours
Course 4	600 hours
Course 6	600 hours
Course 7	600 hours
Course 8	600 hours
Course 9	6 months

20. Thesis

All courses, IV Year.

Every student in the Fourth Year is required to prepare a thesis on an approved subject. Instructions will be issued by the departments concerned.

In some cases written presentation is required, in others oral and written, or it may consist of a research problem followed by a written thesis or report.

DEPARTMENT OF CIVIL ENGINEERING

100. Applied Mechanics. C. F. Morrison, M. W. Huggins, A. C. Davidson, S. M. Uzumeri, B. Goodal, M. Meipoom, R. G. Tress, J. Timusk, G. T. Will.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

This subject is divided into two parts, statics and dynamics.

Statics: The principles of statics are discussed, and applied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and simple three-dimensional structures.

Dynamics: Theoretical principles and practical applications are discussed for:

Particle motion on straight and curved paths; work energy and power; impulse and momentum; plane translation and rotation of rigid bodies.

Text book: Engineering Mechanics—Higdon and Stiles (Second Edition).

101. Statics. R. A. Collins, J. Schwaighofer.

Course 5, I Year; 2 hrs. lectures per week, first term.

Translational and rotational resultants and equilibrants are discussed together with equivalent force systems in two and three-dimensional space. Emphasis is placed on systems in equilibrium. A variety of applications is studied including frameworks, simple machines, and bending moments and shearing forces in beams.

Text book: Mechanics for Engineers: Statics—Beer & Johnston (Second Edition).

102. Mechanics of Materials. J. D. Barber, E. Karuks, K. Meipoom.

Courses 2, 4, 6, 8 and 9, II Year; 2 hrs. lectures per week, both terms.

In this subject, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pressure vessels, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Text book: Mechanics of Materials—Higdon, Ohlsen and Stiles.

103. Mechanics of Materials. R. A. Collins.

Course 5, II Year (elective); 2 hrs. lectures per week, second term.

Basic relationships between force, stress, strain, and deflection of bodies made of various engineering materials are discussed. Beams, columns, shafts, tension members and pressure vessels are analysed and designed for strength and stiffness.

Text book: Mechanics of Materials—Popov.

104. Mechanics of Materials Laboratory: General. W. L. Sagar, C. E. Helwig, C. W. Dillane, J. D. Barber, R. G. Tress.

Courses 1, 2, and 9, II Year; 3 hrs. laboratory per week, second term.

Course 5, II Year (elective); 3 hrs. laboratory per week, second term.

Courses 3, 4, 7 and 8, II Year; 3 hrs. laboratory per week, first term.

An introduction to testing machines, strain and other measuring devices and standard specifications.

The experimental study of some engineering materials and structural members under external load.

No laboratory report shall be written outside the assigned teaching hours.

105. Mechanics of Materials I. D. J. L. Kennedy, S. M. Uzumeri.

Courses 1 and 3, II Year; 2 hrs. lectures per week, both terms.

An introduction to the elastic and inelastic behaviour of solids under various external loading conditions. Strains, stresses and deformations are determined for members subjected to tension, compression, torsion and bending and for pressure vessels by using basic strength of materials theories.

Text: Mechanics of Materials—Popov.

106. Mechanics of Materials. A. C. Davidson.

Course 7, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The fundamental relations among stress, strain and applied load are worked out for tension, compression, twisting and bending in the elastic and inelastic ranges, for various engineering materials. Buckling phenomena are examined for struts and columns. Numerical applications are done in lectures; and problems are assigned for study.

Text: Mechanics of Materials—Popov.

110. Mechanics of Materials II. J. Schwaighofer, K. Meipoom.

Course 1, Group A, III Year; 2 hrs. lectures per week, both terms.

Cement and concrete technology; behaviour of metals; special topics on bending of beams; failure theories; introduction to experimental stress analysis. Problems and laboratory under Course 113.

Text books: Reinforced Concrete Fundamentals—Ferguson; Concrete Manual by U.S. Bureau of Reclamation. Mechanics of Materials—Popov.

Reference book: Concrete Technology I & II—D. R. Orchard.

111. Structural Design. M. W. Huggins.

Course 1, Group A, III Year; 2 hrs. lectures per week, both terms.

An elementary study of the stress analysis and design of structures, structural members, and their details.

The work covered includes steel and timber tension members, compression members and flexural members, including box girders and plate girders and continuous as well as simple span beams. Welding, riveting and high tension bolting, as methods of connecting structural members, are studied. Design and analysis problems under Course 113.

Text book: Design of Steel Structures—Gaylord and Gaylord.

Reference book: Structural Problems—Young and Morrison.

112. Structural Theory I. C. F. Morrison.

Course 1, Group A, III Year; 3 hrs. lectures per week, second term.

The stress analysis of simple span, continuous and cantilever trusses. Influence lines and index stresses. Truss deflections by analytical and graphical methods. Analysis of statically indeterminate trusses, beams and frames by various methods.

Problems under Course 113.

Text book: Structural Theory—Sutherland and Bowman.

113. Structural Laboratory. Staff in Civil Engineering.

Course 1, Group A, III Year; 7½ hrs. per week, first term, 6 hours per week, second term.

Problems and laboratory to complement subjects 110, 111, and 112. 3 hours per week of the above time in the first term will be devoted to the Cements and Concrete laboratory; the balance will be on problems.

114. Structural Engineering I. G. T. Will.

Course 1, Group B, III Year; 2 hrs. lectures per week, both terms.

An introduction to the analysis and design of structures, structural members and their details.

The work covered includes steel and timber columns, tension members and connections.

Problems under Course 115.

Text books: Design of Steel Structures—Gaylord & Gaylord. Theory of Simple Structures—Shedd & Vawter.

Reference book: Structural Problems—Young and Morrison.

115. Structural Laboratory. C. Hershfield, E. Karuks, G. T. Will.

Course 1, Group B, III Year; 3 hrs. alternate weeks in first term, and 3 hrs. per week, second term.

Design and analysis problems to complement subject 114.

116. Reinforced Concrete I. S. M. Uzumeri.

Courses 1A, 1C & 1D, IV Year; 2 hrs. per week, both terms.

The analysis and design of reinforced concrete beams, columns, slabs, footings and retaining walls.

Problems under Course 120 for Course 1A. Problems under Course 121 for Courses 1C and 1D.

Text book: Reinforced Concrete Fundamentals—Ferguson.

Reference books: Theory & Practice of Reinforced Concrete—Dunham. Reinforced Concrete Design—Sutherland and Reese.

117. Reinforced Concrete II. M. W. Huggins.

Course 1A, IV Year; 2 hrs. per week, both terms.

Ultimate design; prestressed concrete; composite design; design of building frames, arches and bridges. Behaviour of reinforced concrete members.

Problems under Course 120.

Text book: Reinforced Concrete Fundamentals—Ferguson.

Reference books: Theory & Practice of Reinforced Concrete—Dunham. Reinforced Concrete Design—Sutherland and Reese.

118. Behaviour and Design of Steel Structures. D. J. L. Kennedy.

Course 1A, IV Year; 2 hrs. per week, both terms.

A continuation of Course 111. The behaviour of structural elements and structures is discussed and related to design methods and criteria. Topics include, repeated loading, buckling, inelastic behaviour, analysis and design of metal structures by ultimate load procedures.

Problems under Course 120.

Text book: Plastic Design of Steel Structures—Beedle.

119. Structural Theory II. G. Kani, R. A. Collins.

Course 1A, IV Year; 2 hrs. per week, first term, 3 hrs. per week, second term.

Analysis of statically indeterminate structures; influence lines for statically indeterminate structures; the use of strain energy, slope deflection, moment distribution, column analogy and Kani methods; an introduction to plates and shells.

Problems under Course 120.

120. Thesis Project, Laboratory and Seminar. Staff in Civil Engineering.

Course 1A, IV Year; 12 hrs. per week, first term and 10 hrs. per week, second term.

Project, problems and Mechanics of Materials laboratory to supplement courses 116, 117, 118, 119 and 140.

121. Structural Laboratory. Staff in Civil Engineering.

Courses 1C and 1D, IV Year; 3 hrs. per week, both terms.

Design and analysis problems, and testing laboratory to supplement course 116.

122. Structural Engineering II. C. Helwig.

Course 1B, IV Year; 2 hrs. per week, both terms.

Cements and concrete; design and analysis of reinforced concrete members; design of steel structures as an extension to course 114. Problems and concrete laboratory under course 123.

Text books: Reinforced Concrete Fundamentals—Ferguson. Design of Steel Structures—Gaylord & Gaylord.

123. Structural Laboratory.

Course 1B, IV Year; 4½ hrs. per week, first term and 3 hrs. per week, second term.

Design and analysis problems to supplement course 122. In the first term 3 hours per week will be devoted to Cements and Concrete laboratory.

124. Elementary Structural Engineering. A. C. Davidson.

Courses 2 and 4, III Year; 1 hr. lecture per week first term; 2 hrs. lectures per week, second term.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject No. 125).

Text books: Design of Steel Structures—Gaylord & Gaylord. Properties of Sections Book Two, Canadian Institute of Steel Construction, Toronto. National Building Code of Canada—National Research Council, Ottawa. Basic Reinforced Concrete Design—Large.

125. Structural Engineering Problems. C. Hershfield, A. C. Davidson, E. Karuks.

Courses 2 and 4, III Year; 3 hrs. per week, second term.

Problems supplementing the work covered in lecture course 124 are assigned and worked out in the drafting room.

126. Structural Engineering. J. D. Barber.

Course 3, IV Year; 2 hrs. lectures per week, second term.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject 127).

Moving loads on simply supported beams; tension, compression and flexural member details; slabs and footings.

Text book: Design of Steel Structures—Gaylord & Gaylord.

127. Structural Engineering Problems. C. Hershfield, J. D. Barber, E. Karuks.

Course 3, IV Year; 3 hrs. per week, second term.

Problems supplementing the work covered in lecture course 126.

130. Construction Management and Business. M. G. Tallon, F. N. Beard.

Course 1, IV Year; 2 hrs. lectures per week, second term.

A study of heavy and building construction, including job planning and organization, construction methods and equipment, superintendence, job records, labour relations and safety procedures. Elements of business organization and management with an introduction to the principles of control through accounting records and financial statements.

135. Descriptive Geometry. C. A. Wrenshall, H. R. Frizzle.

All courses, 1 Year; 1 hr. lecture per week, both terms.

These lectures deal with the principles of orthographic, oblique and perspective projection and their use in solving problems of straight lines, planes, and curved surfaces.

Text book: Descriptive Geometry—Watts and Rule.

137. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle, A. W. Walker.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 9 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry and applied mechanics. An introduction to graphical methods of solving engineering problems, e.g., nomography, empirical equations, graphical algebra and calculus, projective geometry. Problems in mathematics (calculus, analytical geometry and algebra). Plotting of original surveys for courses 1, 2 and 9.

Text book: Engineering Drawing—French and Vierck, 9th edition.

138. Engineering Problems and Drawing. C. A. Wrenshall.

Course 1, II Year; 6 hrs. per week, both terms.

Problems in descriptive and projective geometry, nomography, graphical calculus. Graphs and empirical equations. Structural drawing. Plotting of original surveys. Problems in mathematics.

Text book: Engineering Drawing—French and Vierck, 9th edition.

139. Engineering Mathematics Problems. G. J. Kani; C. A. Wrenshall.

Course 1, III Year; 3 hrs. per week, alternate weeks first term, 3 hrs. per week, second term.

Problems based on the content of Lecture Course 141.

140. Mathematical Applications. R. A. Collins.

Courses 1A, 1C, 1D, IV Year; 2 hrs. lecture per week, first term.

The formulation, discussion and solution of certain civil engineering problems by numerical methods, relaxation techniques, electronic computation, and other approximations.

141. Engineering Mathematics—G. J. Kani.

Course 1, III Year; 2 hrs. lectures per week both terms.

Differential equations; series and theory of functions as applied to Civil Engineering.

142. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle.

Course 5, I Year; 6 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry and applied mechanics. Problems in mathematics (algebra and geometry, and calculus).

Text book: Engineering Drawing—French and Vierck, 9th edition.

143. Engineering Problems and Drawing. C. A. Wrenshall.

Course 8, II Year; 3 hrs. per week, both terms.

Problems in descriptive geometry and mathematics. Graphs and empirical equations.

Text book: Engineering Drawing—French and Vierck, 9th edition.

144. Mathematics Problems. C. A. Wrenshall.

Courses 2, 6 and 9, II Year; 3 hrs. per week, alternate weeks, both terms.

Problems in mathematics.

150. Surveying. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 1, 2 and 9, I Year; 1 hr. lecture per week, first term.

General principles and practice of surveying with the tape, the transit, and the level, and computation of corrections, azimuths, bearings, latitudes and departures, co-ordinates and areas.

Text book: Surveying—Philip Kissam.

Reference books: Plane Surveying—Tracy. Elementary Surveying—Breed and Hosmer. Surveying—Breed.

151. Surveying Field Work. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 1, 2 and 9, I Year; 3 hrs. per week, first term.

Practice in chaining; keeping of field notes; the use of the transit in surveying closed figures and traverse lines; plotting by co-ordinates; computing areas; instrumental work with the level and calculating and volume of excavations.

153. Surveying. O. J. Marshall. B. J. Haynes.

Course 1, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Simple, reverse, compound and spiral curves as applied to Highway and Railroad surveying. Main features of mine and hydrographic surveying. Construction surveying dealing with cross sectioning, earthwork, quantities, mass or haul diagram, super elevation, vertical curves, and layout of roads and sewers.

Text book: Route Surveys—Skelton.

154. Surveying Laboratory. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Course 1, II Year; 3 hrs. per week, both terms.

First Term: Field problems, in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy, and earth work quantities.

155. Surveying. H. L. Macklin.

Courses 2 and 9, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Mine surveying, with problems related thereto. Simple curves, stadia and plane table topographical surveying. Practical determination of time, latitude and azimuth by methods adapted to the surveyor's transit.

Text book: Surveying for Civil Engineers—Kissam.

156. Surveying Laboratory. H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 2 and 9, II Year; 3 hrs. per week, first term; 2 hrs. per week, second term.

First term: Field problems in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy, and mine surveying problems.

157. Practical Astronomy. H. L. Macklin.

Course 1, II Year; 2 hrs. lectures per week, second term.

The derivation of formulae and their application to the solution of spherical triangles and practical problems. Practical determination of time, latitude and azimuth by methods adapted to the use of the surveyor's transit. The subject will be designed to enable the student to carry out these observations at the Summer Survey Camp.

Text book: Practical Astronomy—Nassau.

158. Survey Camp. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Course 1, III Year; Aug. 19 to Sept. 20; Courses 2 and 9, III Year; Aug. 26 to Sept. 20—Gull Lake or Dorset.

Course 1:

(a) Secondary Triangulation and Base Line Measurements.

(b) Highway and Railway Location.
(c) Cross Sectioning and Computation of Earthwork.
(d) Stadia and Plane Table Topography.
(e) Observations for Time, Azimuth, and Latitude.

Courses 2 and 9:

(a) Stadia and Plane Table Topography.
(b) Mine Surveying, using overhead stations.
(c) Shaft plumbing and use of Auxiliary Telescope.

Students in Courses 1, 2 and 9 will be required to take the Survey Camp between the Second and Third Years; on failure to do so, this subject will be carried as a supplemental in the Third Year.

Application to defer attendance at the Camp must be made to the Secretary of the Faculty before July 15th.

159. Least Squares.

Course 1B, III Year; 3 hrs. laboratory per week, first term.

The general principles of probability of errors, elementary problems illustrating the application of Least Squares to the adjustment of observations, empirical constants and formulae.

No laboratory reports shall be written outside the assigned teaching hours.

Text book: Least Squares in Engineering—Marshall and Macklin.

160. Geodetic Engineering. O. J. Marshall.

Course 1B, III Year; 2 hrs. lectures per week, second term.

Principles, equipment and methods of geodetic survey involving triangulation, traverse and levelling of high precision; elementary geodesy and map projections.

161. Geodetic Engineering Laboratory.

Course 1B, III Year; 3 hrs. per week, second term.

Problems and computations supplementing the work covered in subject 160.

162. Optics and Photogrammetry. J. Vlcek, D. J. Gerrard.

Course 1B, III Year; 2 hrs. lectures per week, first term.

Optics of modern surveying instruments, including cartographic camera; photographic materials and processes as they affect the interpretability of photographs; camera calibration, geometry of a single picture, stereoscopy, simple methods of plotting from terrestrial and aerial photographs.

163. Optics and Photogrammetry Laboratory. J. Vlcek, D. J. Gerrard.

Course 1B, III Year; 3 hrs. per week, first term.

Laboratory work supplementing the lecture course 162.

164. Photo Interpretation. J. Vlcek, D. J. Gerrard.

Course 1B, III Year; 2 hrs. lectures per week, second term.

The use of aerial photographs in geology, land use, forestry,

etc.; methods of extracting, and displaying the information available—all based on the use of a large collection of diversified photography.

165. Photo Interpretation Laboratory. J. Vlcek, D. J. Gerrard.
Course 1B, III Year; 3 hrs. per week, second term.
Laboratory work supplementing the lecture course 164.

167. Survey Camp. O. J. Marshall, B. J. Haynes.
Course 1B, IV Year; Aug. 26 to Sept. 20 Dorset.
Triangulation, electronic distance measurements, traverses, levelling and astronomical observations by precise methods.

168. Adjustment of Observations and Computer Programming. H. L. Macklin.
Course 1B, IV Year; 2 hrs. lecture per week, second term.
Probability and the theory of accidental errors. Least Squares and its application in the adjustment of surveys. Digital computer programming and applications in survey calculations involving closed figures, area calculations and quantity computations.

169. Adjustment of Observations and Computer Programming. H. L. Macklin.
Course 1B, IV Year; 3 hrs. laboratory per week, both terms.
Problems illustrating the application of least squares to the adjustment of observed data, with particular reference to surveying measurements. Computing experience with desk calculator and digital computer solving surveying problems involving closed traverses, area and quantity computations.

170. Advanced Photogrammetry. J. Vlcek.
Course 1B, IV Year; 2 hrs. lecture per week, first term.
Advanced methods in photogrammetry including analytical methods of aerial triangulation and trilateration; the application of photogrammetry to highway location and designs.

171. Advanced Photogrammetry Laboratory.
Course 1B, IV Year; 4½ hrs. laboratory per week, first term.
A laboratory course supplementing subject No. 170.

172. Astronomy. H. L. Macklin.
Course 1B, IV Year; 1 hr. lecture per week, first term.
Precise determination of time, latitude, longitude and azimuth as applied to geodetic surveys.

173. Astronomy Laboratory. H. L. Macklin.
Course 1B, IV Year; 3 hrs. laboratory per week, first term.
Observations and problems to accompany subject 172.

174. Engineering and Legal Surveys. B. J. Haynes.
Course 1B, IV Year; 2 hrs. lecture per week, first term, and 1 hr. lecture per week, second term.

Construction surveying problems dealing with prismoidal volumes and corrections, hydrographic surveying, tunnel surveying, circular curve intersections, area computations, chronological order of land subdivision and layout from early township patterns to present day subdivisions, the weighing of survey evidence in the retracement of construction and legal surveys, and the preparation of legal surveys.

175. Geodesy. O. J. Marshall.
Course 1B, IV Year; 1 hr. lecture per week, both terms.
Geometry of the spheroid, geographic co-ordinates, common map projections with related co-ordinate systems.

176. Geodesy Laboratory. O. J. Marshall.
Course 1B, IV Year; 3 hrs. laboratory per week, second term.
Problems in geodetic computations.

180. Sanitary Engineering. A. P. Bernhart.
Course 1, III Year; 2 hrs. lectures per week, first term.
The objective of Sanitary Engineering and Pollution Control. Basic outline of problems of urbanization and the natural cycle of water. Water Purification: treatment of domestic and industrial waste waters. Municipal Services—water mains, sanitary sewers, storm water drainage, garbage disposal. Air Pollution Control—equipment and planning considerations.

181. Air and Water Resources. A. P. Bernhart.
Course 1C, IV Year;
2 hrs. lectures per week, first term.
3 hrs. lectures per week, second term.
Water Resources: Natural cycle of water. Pollution by urban developments. Self-purification of natural water bodies. Watershed planning.
Water Purification: Screens, coagulation, sedimentation, filtration, chlorination, fluoridation, softening, iron removal, pumping, storing, metering.
Waste Water Treatment: Screens, grit removal, sedimentation, activated sludge process, trickling filters, chlorination, tertiary treatment, sludge digestion and dewatering. Industrial waste waters.
Air Resources: Natural air movements, micro climates. Causes, effects, history and disasters of air pollution. Aerosols and gaseous pollutants. Control by planning and cleanlinness. Dust collectors, gas washers and absorbers, electro-static precipitators.
Pollution Control: As one problem of urbanization, the engineer's responsibility toward the society.

182. Municipal Engineering and Planning. A. P. Bernhart, G. W. Heinke.
Course 1C, IV Year, 2 hrs. lectures per week both terms.
Planning: Units of urban planning and their layout; aspects and implementation of planning.

Roads: Layout of systems, cross sections, construction.

Water Supply: Long distance transmission, distribution.

Sanitary and storm sewers: Systems, pumping stations, drainage.

Complete service systems for urban areas: design, administration and financing.

Analysis of Water Pollutants: Physical, chemical, biological. (Turbidity; hardness, oxygen, nitrogen and carbon; microorganisms.)

183. Thesis Project, Laboratory and Seminar. A. P. Bernhart, R. A. Collins, M. M. Davis, G. W. Heinke.

Course 1C, IV Year; 7½ hrs. per week, first term, 7 hrs. per week, second term.

Thesis project and design problems supplementing courses 140, 181, 182, 187.

Several inspection field trips and reports on Water and Wastewater Plants, Subdivision Construction, Airpollution Control Installations.

Laboratory work on standard testing methods for air and water pollution.

185. Highway Engineering. M. M. Davis.

Course 1, III Year; 2 hrs. lectures per week, first term.

Organization, administration, economics and planning of rural highways; highway materials and paving; principles of location, design, construction and maintenance.

Text Book: Highway Engineering—Hewes and Oglesby.

Reference Books: The Highway Improvement Act—Ontario Highway Standards and Specifications—Department of Highways of Ontario. Soil Mechanics for Road Engineers—D.S.I.R.—H. M. Printer, Policy on Geometric Design of Rural Highways—A.A.S.H.O.

186. Municipal Planning, Administration and Transportation. H. L. Macklin, M. Hugo-Brunt, M. M. Davis.

Course 1, III Year; 3 hrs. lectures per week, second term.

Contemporary concepts in town and regional planning and their theoretical, practical and legal applications as applied in Canada.

Organization of municipal government, municipal finance, legislation governing municipal operation, role of the municipal engineer and private practitioner in public works, provisions of municipal services.

Urban and regional growth as affected by transportation, trends, demands, characteristics and capacities, co-ordination with land use and integration with other services.

187. Highway Engineering II. M. M. Davis.

Course 1C, D, IV Year; 2 hrs. lecture per week, second term.

Elementary traffic characteristics, traffic control, control devices, and geometric design elements.

Text Book: Traffic Engineering—Matson, Smith & Hurd.

Reference Books: A.A.S.H.O. Policy on Geometric Design—Rural Highways; A.A.S.H.O. Policy on Geometric Design—Urban Highways.

188. Transportation Engineering. M. M. Davis.

Course 1D, IV Year; 3 hrs. lecture per week both terms.

Transportation systems: Highway, railroad, shipping, pipelines, conveyors, airports. Structural design of pavements.

189. Air Photo Interpretation.

Course 1D, IV Year; 1 hr. lecture per week, first term.

Analysis and interpretation of aerial photographs for the prediction of engineering properties of soils.

191. Soil Mechanics. W. L. Sagar, F. A. De Lory.

Course 1, III Year; 2 hrs. lectures per week, first term.

Identification and classification of soils for engineering purposes; weight volume relationships, compaction; permeability and drainage characteristics; consolidation; field exploration and sampling; stress-deformation characteristics; shearing strength.

Reference Texts: Foundation Design—Teng; Foundation Engineering—Peck, Hanson and Thornburn.

192. Soil Mechanics and Foundations. W. L. Sagar, F. A. De Lory.

Course 1A, C, D, IV Year; 2 hrs. per week, first term, 1 hr. per week, second term.

Shearing strength of soils, consolidation and settlement, slope stability, bearing capacity, footings, retaining walls, braced cuts, piling, dewatering.

Reference Texts: Foundation Design—Teng; Foundation Engineering—Peck, Hanson and Thornburn.

193. Earth Structures and Foundations. W. L. Sagar, F. A. De Lory.

Course 1D IV Year; 3 hrs. per week, both terms.

Properties of unsaturated soils, fills, embankments, earth and rockfill dams, seepage, flow nets, sheet pile bulkheads, cellular cofferdams, geotechnical processes, tunnels, underpinning.

Reference books: Soil Mechanics in Engineering Practise—Terzaghi and Peck; Pile Foundations—Chellis; Proceedings of Soil Mechanics Conferences.

195. Soil Mechanics and Highway Laboratory. Staff in Civil Engineering.

Course 1 III Year; 3 hrs. per week, first term.

A series of laboratory and problem periods to accompany courses in Soil Mechanics (191) and Highway Engineering I (185).

196. Soil Mechanics Laboratory. W. L. Sagar, F. A. De Lory.

Course 1A, C, D, IV Year; 2 hrs. laboratory per week, second term.

Laboratory experiments and testing to accompany Soil Mechanics and Foundations (192).

No laboratory reports to be written outside assigned laboratory hours.

197. Air Photo Interpretation Laboratory.

Course 1D, IV Year; 3 hrs. laboratory per week, first term.

Laboratory periods to accompany Air Photo Interpretation (189).

198. Thesis Project, Laboratory and Seminar. Staff in Civil Engineering.

Course 1D, IV Year; 6 hrs. per week, first term; 7 hrs. per week, second term.

Problem and laboratory periods to accompany subjects 140, 188 and 193.

DEPARTMENT OF MINING ENGINERING

201. Assaying. W. A. M. Hewer.

Courses 2, 8, and 9, III Year; 1 hr. lecture per week, both terms.

Theory and practice of fire assaying. Emphasis is laid not only upon the principles of chemistry, metallurgy and sampling involved, but also upon the errors inherent in operators as well as in methods.

References: Manual of Fire Assaying—Fulton and Sharwood. Textbook of Fire Assaying—Bugbee. Fire Assaying—Shepherd and Dietrich. The Sampling and Assay of the Precious Metals—E. A. Smith.

202. Assaying Laboratory. W. A. M. Hewer.

Courses 2 and 9, III Year; 3 hrs. laboratory per week, both terms.

The determination of precious metals. Scorification, crucible and combination wet and dry methods of assaying ores both simple and complex; milling and metallurgical products including cyanide solutions, cyanide precipitates and gold bullion. Attention is also given to the sampling and assay of ores containing radio-active minerals.

203. Wet Analysis. W. A. M. Hewer.

Course 2, III Year; 3 hrs. laboratory per week, both terms.

Analysis of furnace products, base metal, and radioactive ores.

204. Assaying Laboratory. W. A. M. Hewer.

Course 8, III Year; 3 hrs. laboratory per week, first term.

The instruction in general is as described under subject 202, but omitting determinations on precious-metal bullions and radio-active minerals.

221. Mining. H. R. Rice, W. A. M. Hewer.

Courses 2 and 9, II Year; 1 hr. lecture per week, both terms, and 2 hrs. laboratory per week, second term.

A combined lecture and laboratory subject in the principles of mining and its unit processes. Emphasis is placed on the statistical approach to sampling calculations.

222. Mining. H. R. Rice.

Courses 2 and 9, III Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Methods of mine development by mine adits, shafts, drifts and crosscuts; stoping methods, loading, and underground transportation.

223. Mining Laboratory. H. R. Rice, S. E. Wolfe.

Course 2, III Year; 3 hrs. laboratory per week, first term; 2 hrs. laboratory per week, second term.

Special mining problems are given relating to sampling, diamond drilling, stope measurements, the factors affecting the behaviour of broken materials. To develop the individual student's initiative, some special survey problems are worked in the laboratory.

224. Mine Operation and Administration. H. R. Rice.

Courses 2 and 9, IV Year; 2 hrs. lectures per week, both terms.

Lectures on advanced mining practice, including mining methods, ground control, mine mechanization, mine services and plant, aspects of administration and finance, and industrial relations.

225. Mining Laboratory. H. R. Rice.

Course 2, IV Year; 2 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A problem which progresses from essential geological data, to a complete design of the related mine, which integrates the principles of mine economics, selection of mining rates, ore-reserve calculations, and plant design.

226. Mining Laboratory. H. R. Rice.

Course 9, IV Year; 3 hrs. laboratory per week, second term.

Problems in mine layout involving shaft location and size; mine development; choice of stoping methods, mining rate, and mine equipment; time and cost schedules; ore reserve calculations.

251. Mine Ventilation Laboratory. The Staffs in Mining and Mechanical Engineering.

Course 2, IV Year; 3 hrs. laboratory per week, first term.

Experiments in the laboratories and problems in the study room to give the student some practice in the use of ventilation test equipment, and the solution of ventilation problems. An aggregate of about ten off-campus study hours may be required in preparation of some reports. This subject relates to subject 321.

241. Mineral Dressing. S. E. Wolfe.

Courses 2 and 8, III Year; 2 hrs. lectures per week, both terms.

The subject deals with the economics of, the theoretical principles and their practical application in, the treatment of ores and mineral aggregates. These involve the processes of crushing, grinding, sizing and classification; gravity, magnetic, and electrostatic separation; and an introduction to froth flotation. In addition, ancillary processes are studied. These include flocculation, sedimentation, filtration, drying of mineral products and the precipitation and collection of dust and fume.

242. Mineral Dressing Laboratory. S. E. Wolfe.

Course 8, III Year; 6 hrs. laboratory per week, second term.

The subject matter in general is as described under Subject 243, but with more emphasis on processes involving surface phenomena.

243. Mineral Dressing Laboratory. S. E. Wolfe.

Course 2, III Year; 6 hrs. laboratory per week, second term.

This work is coordinated with the lecture subject 241. Studies are made of crushing machinery, the principles of crushing and grading of rock products, screen analysis, and the sampling of broken material and mill products. Certain tests with gravity concentrating machines are made and an introduction to the technique of flotation test work is given.

244. Ore Dressing. S. E. Wolfe.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The subjects covered are extensions of those in 241, 242, and 243; cyanidation, flotation processes and techniques, the current practice at milling plants, and problems associated with milling.

245. Ore Dressing Laboratory. S. E. Wolfe.

Course 2, IV Year; 6 continuous hours per week, first term.

Advanced work coordinated with lecture subject 244 and pertaining to ore dressing appliances, the handling in bulk of finely divided solids, the selective flotation of sulphides, ore testing, and pilot plant mill runs.

246. Mineral Dressing. S. E. Wolfe.

Course 9, III Year; 2 hrs. lectures per week, first term.

This abridged subject deals with current practice and fundamental principles in the field of mineral beneficiation.

261. Summer Essay. W. A. M. Hewer.

Course 2, III Year:

An essay, or report, written on a mining topic, preferably some phase of work with which the student is associated during summer employment. Subsequently, each student will deliver a talk to his class on the topic chosen. Thus, training is afforded in both technical writing and public speaking. Students are briefed in advance concerning requirements of this subject.

271. Oral Expression. Mrs. Helen Tuker.

Courses 2 and 9, II Year; 2 hrs. seminar per week, second term.

A seminar series in oral expression. The objective is to improve the ability to speak as a means of communication. Clear expression of sound thinking is discussed and practised in speech assignments.

275. Thesis Project, Laboratory and Seminar. The staff in Mining Engineering.

During the Fourth Year of his Course, each student is required to select an area of investigation suitable to the Department and to give both oral and written findings arising from his pursuit of it. General instructions are given to the student before the close of the preceding Session in order to assist a considered choice.

DEPARTMENT OF MECHANICAL ENGINEERING

302. Engineering Thermodynamics. A. B. Allan.

Course 1, II Year; 2 hrs. lectures per week, second term.

The fundamentals of engineering thermodynamics. The First and Second Laws. Properties of substances. Heat transfer. Heat exchangers. Compressors, fans, pumps, reciprocating engines and turbines. Vapour and gas power cycles. Refrigeration. Air-conditioning.

Text book: Basic Thermodynamics—Brown.

303. Elementary Heat Engineering P. B. Hughes.

Course 3, II Year; 2 hrs. lecture per week, second term.

The history and development of heat engines, the principles upon which they operate, and the characteristic features of the different kinds of engines used in practice. The First and the Second laws of thermodynamics.

Text book: Elements of Thermodynamics and Heat Transfer—Obert and Young.

Reference books: Thermodynamics of Heat Power—Faires. Steam, Air and Gas Power—Severns, Degler and Miles.

306. Engineering Thermodynamics. C. H. Miller.

Course 2, III Year; 1 hr. lecture per week, both terms.

Thermodynamics of gases and vapours as applied to engines, nozzles, turbines, compressors, heat exchangers, refrigeration plants, and air conditioning systems. Analysis of vapour and gas power cycles.

Text book: Thermodynamics of Heat Power—Faires.

307. Heat Engineering Laboratory.

Course 2, III Year; 3 hrs. laboratory per week, second term.

This laboratory is complementary to subject number 306. The testing procedures and evaluation methods applicable to prime mover and compressor equipment are emphasized.

Text Book: The Engineering Report in the Undergraduate Laboratory—Hughes.

308. Heat Engineering. F. C. Hooper, W. A. Wallace.

Course 3, III Year; 2 hrs. lecture per week, first term; 1 hr. lecture per week, second term.

Steam Generators. Combustion calculations; analysis of fuels and products of combustion; boiler tests and heat balance; principles of design of boilers, furnaces, stokers, pulverised fuel, oil and gas firing equipment, economizers, air heaters, superheaters, feedwater heaters.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, McNaughton, Zerban and Nye.

Internal Combustion. Types and operation; performance and testing; basic characteristics and principles of design; carburation; fuel injection; governing.

Text book: The Internal Combustion Engine—Taylor and Taylor.

Reference book: Internal Combustion Engines—Fraas.

Heat Transfer and Air Conditioning. Conduction, convection, radiation, and combined mechanisms of heat transfer. Air and water vapour mixtures, requirements for comfort and industrial processes; the use of psychrometric charts; heating, cooling humidifying and dehumidifying processes; calculation of air conditioning loads; air conditioning systems and equipment.

Reference book: A.S.H.R.A.E. Guide.

309. Engineering Thermodynamics. F. C. Hooper.

Course 3, III Year; 2 hrs. lectures per week, both terms.

A continuation of subject 303.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer. Regeneration.

Text book: Elements of Thermodynamics and Heat Transfer—Obert and Young.

310. Heat Engineering Laboratory.

Course 3, III Year; 3 hrs. laboratory per week, both terms.

This laboratory is complementary to lecture subjects 303, 308 and 309. The experimental work, conducted on a broad range of heat and power equipment, is intended to offer experience in the design, organization and execution of experimental investigations of thermal apparatus, in the application and evaluation of the associated instrumentation, in the treatment of the data, and in the interpretation and reporting of the work.

Text Book: The Engineering Report in the Undergraduate Laboratory—Hughes.

311. Engineering Thermodynamics. R. W. P. Anderson

Course 4, III Year; 2 hrs. lectures per week, first term.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles used in practice for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer.

Text book: Thermodynamics of Heat Power—Faires.

312. Heat Engineering Laboratory.

Course 4, III Year; 3 hrs. laboratory per week, second term.

This laboratory is complementary to lecture subject 311. Selected experiments are conducted in illustration of the methodology of experimental investigation of the external characteristics of thermal devices and systems, with special attention given to the peculiar interests of the engineer primarily concerned with economic considerations.

Text Book: The Engineering Report in the Undergraduate Laboratory—Hughes.

313. Heat Engineering. C. H. Miller

Course 5t, III Year; 2 hrs. lectures per week, both terms.

This course consists of a study of the fundamental concepts of macroscopic thermodynamics, and their applications to closed and open dynamic systems. An examination of the principal power cycles is undertaken in relation to the properties of the working media involved. Emphasis is placed on a thorough understanding of the three basic laws of thermodynamics.

Text book: Concepts of Thermodynamics—Obert

Reference Books: Engineering Thermodynamics—Hall and Ibele.

Thermodynamics—Van Wylen.

314. Heat Engineering Laboratory.

Course 5t, III Year; 3 hrs. laboratory per week, both terms.

This laboratory is complementary to lecture subject 313. The course emphasizes the philosophy and techniques used in the experimental investigation of the performance of heat engineering equipment.

Text Book: The Engineering Report in the Undergraduate Laboratory—Hughes.

315. Engineering Thermodynamics. P. B. Hughes.

Course 6, III Year; 2 hrs. lecture per week, first term.

The theory and practice of heat engines, including a study of fundamental principles involved, an appraisal of theoretical developments, and a survey of the corresponding practical applications.

Text book: Thermodynamics of Heat Power—Faires.

316. Heat Engineering Laboratory.

Course 6, III Year; 3 hrs. laboratory per week, second term.

This laboratory is complementary to lecture subject 315. Experiments are conducted on heat engineering equipment presenting testing and control problems similar to those encountered in the process industries.

Text Book: The Engineering Report in the Undergraduate Laboratory—Hughes.

317. Thermodynamics. R. W. P. Anderson.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

A development of the fundamental laws of thermodynamics and of their application in engineering. Internal combustion and steam power, refrigeration, heat transfer, psychrometry and air conditioning.

Text book: Elements of Thermodynamics and Heat Transfer—Obert.

318. Heat Engineering Laboratory.

Course 7, III Year; 3 hrs. laboratory per week, first term.

This laboratory is complementary to lecture subject 317. Particular emphasis is placed on the experimental determination of the control and output characteristics of prime movers and of the energy balances in heat power plants.

Text Book: The Engineering Report in the Undergraduate Laboratory—Hughes.

321. Mine Ventilation and Allied Problems. R. W. P. Anderson

Course 2, IV Year; 2 hrs. lectures per week, first term.

Ventilation problems in Canadian mines, including the use of ventilation equipment, selection of fans, testing equipment, ventilation studies, the silicosis problem, fire control, etc.

322. Internal Combustion. W. A. Wallace.

Course 3, IV Year; 1 hr. lecture per week, both terms.

A survey of present and potential fuel resources. Characteristics of fuels and their combustion requirements. Operating cycles and losses involved, for both the reciprocating engine and the turbine plant. The theory of superchargers and rotary compressors. Factors governing the selection of equipment for an I.C. plant.

Reference book: The Internal Combustion Engine—Taylor and Taylor.

323. Heat Power Engineering. P. B. Hughes.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

A continuation of subjects 308 and 309. Evaporators and miscellaneous heat exchangers. Condensers and auxiliary power plant equipment. Theory and design of turbines. Power plant cycles including reciprocating engines and turbines. Cycles for high pressures and temperatures. Superheating, reheating, regenerative binary-fluid and supercritical pressure cycles. Steam generators

employing forced circulation, indirect evaporation and pressure combustion. Power plant heat balance and efficiencies. Design of power plant equipment. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Heat and Thermodynamics—Zemansky. Engineering Thermodynamics—Obert, Lee and Sears, Soo, Van Wylen, Hawkins and Jones. Steam Power Plants—Gaffert, Zerban and Nye. Steam Turbines—Church, Salisbury, Lee, Shepheard.

324. Heat Engineering Laboratory.

Course 3, IV Year; 3 hrs. laboratory per week, first term, 4½ hrs. laboratory per week, second term.

This laboratory is complementary to lecture subjects 322 and 323. It is an extension of the third year laboratory, subject 310, with an increased demand for individual judgment and a professional outlook.

Text Book: The Engineering Report in the Undergraduate Laboratory—Hughes.

325. Refrigeration and Air Conditioning. F. C. Hooper.

Course 5t, IV Year; 2 hrs. lecture per week, first term.

The thermodynamic cycles and processes of special interest in refrigeration are outlined and the properties of ideal and actual refrigerants examined. Basic psychrometric processes are reviewed and related to air conditioning system performance.

Text book: Theory of Mechanical Refrigeration—Sparks and Di Ilio.

Reference book: A.S.H.R.A.E. Guide.

326. Heat Power Engineering. C. H. Miller

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Application of thermodynamics to the design of power plant equipment of all types including gas turbines, subcritical and supercritical vapour cycles, and combinations thereof. New developments and trends are emphasized by consideration of the problems associated with nuclear reactor energy sources, magnetoplasmadynamics power generation, fuel cells and extra-terrestrial environmental conditions. Departures of real cycles from idealized analytical models are considered in some detail.

References: Cycles and Performance Estimation—Hodge. Analytical Thermodynamics—Soo. Power Plant Theory and Design—Potter. Selected Papers from Current Literature.

327. Internal Combustion. A. B. Allan.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Analysis of the processes and fundamental problems of internal combustion machines. Consideration of the deviations from ideal behaviour. Fuels, combustion, ignition, detonation and other combustion problems. Experimental techniques in the study of internal combustion machines. A consideration of engine design.

Text book: Internal Combustion Engines—Obert.

Reference book: Internal Combustion Engines—Lichty.

328. Heat Transfer. F. C. Hooper.

Courses 5t and 5n, IV Year; 2 hrs. lecture per week, second term.

Steady state and transient conduction, surface and gas radiation, convection, boiling, condensation and combined mechanisms are considered. Special attention is given to analogue and computational procedures and to consideration of the manner in which novel or complex problems may be approached.

Text book: Heat Transmission—McAdams.

329. Heat Engineering Laboratory.

Course 5t, IV Year; 3 hrs. laboratory per week, both terms.

This laboratory is complementary to lecture subjects 325, 326, 327 and 328, and an extension of laboratory subject 314. The laboratory offers an opportunity for specialized individual undertakings.

330. Heat Transfer. C. H. Miller.

Course 8, IV Year; 2 hrs. lecture per week, second term.

Basic principles, definitions, units and dimensional analysis. Conduction in the steady and the unsteady states. The heat source within a conducting body. Free and forced convection. Condensing and boiling. Radiation. Combined effects of conduction, convection and radiation. Instrumentation and experimental methods.

Text book: Heat Transfer—Chapman.

333. Fluid Mechanics. G. R. Lord, L. E. Jones, H. J. Leutheusser.

Courses 1 and 3, III Year; 2 hrs. lectures per week, both terms.

Attention is given to the development and discussion of the fundamental principles of fluid flow. These principles are illustrated by suitable practical problems connected with fluid measurements, flow of fluids in pipes and open channels, with a brief discussion of the resistance of submerged bodies, dimensional analysis and similarity studies.

334. Fluid Mechanics Laboratory

Courses 1 and 3, III year; one 3 hr. laboratory period per week, second term.

This laboratory course is planned to illustrate the principles considered in the lecture courses in fluid mechanics. Experimental work in the laboratory utilizes a wide variety of apparatus and equipment concerned with fluid flow, while problems undertaken in the study room provide a link with general engineering practice.

335. Fluid Flow and Pumping Systems. L. E. Jones, E. Brundrett.

Course 2, III Year; 3 hrs. lectures per week, first term.

A discussion of the fundamental principles of fluid flow, with special attention to problems encountered in mining.

336. Fluid Flow and Pumping Systems Laboratory.

Course 2, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit correlation of flow fundamentals with mining applications.

337. Fluid Mechanics. L. E. Jones, H. J. Leutheusser.

Courses 4, 6, and 8, III Year; 2 hrs. lectures per week, first term.

The fundamentals of fluid flow as generally encountered in industry. Fluid properties, fluid statics, energy relations, dimensional analysis and dynamic similarity, flow in pipes and channels, resistance of submerged bodies, effects of viscosity and compressibility, lubrication, pumps and other hydraulic machines.

338. Fluid Mechanics Laboratory.

Courses 4 and 6, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit of correlating flow fundamentals with industrial applications.

341. Hydraulic Engineering. W. D. Baines.

Course 1, IV Year, Option C; 2 hrs. lectures per week, both terms.

Applications of fluid mechanics to civil engineering problems, particularly discussion of flow in pipes and open channels, surge tanks, water hammer, pumps and turbines. Theory and applications of hydrology including precipitation, run-off, snowmelt, ground water, evaporation and hydrograph analysis.

342. Hydraulic Engineering Laboratory.

Course 1, IV Year, Option C; one 1½-hr. laboratory period per week, first term; one 3-hr. laboratory period per week, second term.

Experimental studies of hydraulic models, turbines and pumps are carried out. Problems assigned in the study rooms deal with channel flow and other hydraulic features connected with water power installations, flood control, water supply and drainage systems.

343. Hydraulic Engineering. L. E. Jones.

Course 1, IV Year, Options A, B, D; 3 hrs. lectures per week, second term.

The general field of hydraulic engineering is studied under the topics: hydrology; ground and surface water; drainage, flood control, power and navigation systems; municipal and industrial applications; model studies; principles of design, operation, and field investigation.

344. Hydraulics. G. R. Lord.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

The general field of applied hydraulics and fluid mechanics is studied under the topics: hydrology; hydro-electric power plants and auxiliaries; conservation and flood control; canals, pipelines, etc., under both steady and unsteady conditions; hydraulic machinery, fans, compressors, turbines, pumps, etc., design, selection and operation; power and control circuits; flow of compressible fluids; similarity and model investigations; industrial applications.

345. Hydraulic Laboratory.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 4½ hrs. laboratory per week, second term.

Experimental work is carried out in the laboratory on various types of pumps, turbines, fans, centrifugal compressors and on hydraulic models. In addition computation problems involving open channel flow, water power studies, pumps and turbine studies, water hammer phenomena, fans and ductwork and other advanced flow problems are considered. General problems involving compressibility of gases are considered.

346. Fluid Mechanics. L. E. Jones.

Course 7, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Physical characteristics of fluids; fundamental concepts of fluid mechanics; experimental techniques and principles of systematic analysis; boundary layers, wakes and turbulence; pipe and channel systems; dynamics of compressibility; oscillations and waves; forces and moments on immersed bodies; fluid machinery; introduction to systems encountered in engineering practice.

347. Fluid Mechanics Laboratory.

Course 7, IV Year; 3 hrs. laboratory per week, second term.

Laboratory experiments and design problems to illustrate subject 346.

350. Dynamics. G. E. Godfrey.

Courses 1 and 4, II Year; 2 hrs. lectures per week, second term.

Motion of a point is reviewed and extended to include Coriolis' acceleration, with applications. Equations for motion of mass in translation, rotation, and plane motion are developed, including centre of percussion. Moment of inertia of mass is studied by double integration and by the lamina method. The derivation and application of gyroscopic action is thoroughly discussed, and an introduction to static and dynamic balancing is given. Elementary vibration theory and problems in vibration isolation are discussed.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics—Part II—Meriam.

351. Dynamics. F. C. Hooper, C. L. Proctor.

Course 5, II Year (elective); 2 hrs. lectures per week, first term.

Simple particle motion. Work and energy. Impulse and momentum. Kinematics of plane motion and Coriolis acceleration. Kinetics of translation and rotation. General kinetics of plane motion. Gyroscopic action. Simple vibrations. Gibbs' Vector Notation.

Reference books: Engineering Dynamics—Hooper and Smith. Mechanics—Part II—Meriam.

352. Dynamics. F. P. J. Rimrott.

Course 7, II Year; 2 hrs. lectures per week first term; 1 hr. lecture per week, second term.

Motion of a point, including Coriolis' acceleration; motion of mass; gyroscopic action; vibration and balancing; electro-mechanical analogies; Gibb's vector notation.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics, Part II—Meriam.

353. Dynamics Laboratory. F. P. J. Rimrott.

Course 7, II Year; 1½ hrs. problems per week, both terms.

Problems in kinematics and kinetics to support subject 352.

355. Mechanical Engineering. R. T. Waines.

Course 3, II Year; 1 hr. lecture per week, first term.

Prior to registering in Second Year, the student is required to study the prescribed text, covering the topics of design materials and manufacturing methods and processes. The lecture work will involve discussion of the text matter, as well as new materials and processes. The final examination (in January) will cover both the prescribed study and the lecture work.

Text book: Manufacturing Processes and Materials for Engineers—Doyle, Morris, Leach and Schrader.

356. Machine Design. I. W. Smith.

Course 3, II Year; 2 hrs. lectures per week, second term.

Design of machine elements—shafts, bearings, belts, couplings, clutches.

Text book: Design of Machine Elements—Spotts.

357. Dynamics of Machines. D. L. Allen.

Course 3, II Year; 3 hrs. lectures per week, both terms.

Basic equations for accelerated motion of mass are developed and applied to the analysis of machine elements. Velocity, acceleration, force distribution, speed fluctuation and balancing of machines are considered. Standard linkages, cams, gears, flywheels, governors and gyroscopes are given specific attention.

Text books: Engineering Dynamics—Hooper and Smith. Kinematics and Dynamics of Machinery—Maxwell.

358. Machine Design Laboratory. R. T. Waines, D. L. Allen, C. L. Proctor.

Course 3, II Year; 6 hours per week, both terms.

Problems in mechanical drawing, descriptive geometry, fits and tolerances, machine tool operations, dynamics of machines, metrology, and design of machine elements.

Text book: Engineering Drawing—French and Vierck, 9th edition.

359. Mechanical Design. R. T. Waines.

Course 4, II Year; 1 hr. lecture per week, both terms.

Machines and Processes. In addition, standards, allowances and fits, metrology and machine tool operations.

Text Book: Manufacturing Processes and Materials for Engineers—Doyle, Morris, Leach and Schrader.

360. Mechanical Design Laboratory. R. T. Waines, B. M. M. Carpendale.

Course 4, II Year; 6 hrs. per week, both terms.

Problems in mechanical drawing, descriptive geometry, fits and tolerances, machine tool operations, machine force analysis, and metrology, the latter being given in the Fine Measurement Laboratory.

Text book: Engineering Drawing—French and Vierck, 9th edition.

363. Machine Design. I. W. Smith.

Course 3, III Year; 2 hrs. lectures per week, first term.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Spotts.

364. Machine Design Laboratory. R. T. Waines, I. W. Smith.

Course 3, III Year; 6 hrs. per week first term, 3 hrs. per week second term.

Design and stress analysis of machine elements; vibration problems and experiments in one and two mass systems.

365. Machine Design. J. VandeVegte.

Courses 5m, 5n, 5p, 5t, III Year; 1 hr. lecture per week, both terms.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Spotts.

366. Machine Design Laboratory. I. W. Smith, R. T. Waines, J. VandeVegte.

Courses 5m, 5n, 5p, 5t, III Year; 3 hrs. laboratory per week, both terms.

The work in the laboratory will consist of the analytical solution of problems illustrating the principles involved in the lecture course, and the standard practice in making assembly and detail machine drawings.

367. Machine Design. G. E. Godfrey.

Course 7, III Year; 2 hrs. lectures per week, first term.

Force analysis; mechanics; velocities, accelerations and inertia forces in machines; principles of stress analysis and the design of various machine elements, including shafting, bearings, belts, gears, etc.; also an introduction to work on speed fluctuation, vibrations and balancing.

Text book: Design of Machine Elements—Spotts.

368. Machine Design Laboratory. R. T. Waines, G. E. Godfrey.

Course 7, III Year; 3 hrs. per week, first term.

Design and stress analysis of machine elements. In the laboratory, the student is given an opportunity to apply the subject material of the lectures to various machine design problems.

371. Machine Design. C. L. Proctor.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The design and selection of machinery and equipment met with in metallurgical plants, and in mining work.

Text book: Design of Machine Elements—Spotts.

372. Machine Design Laboratory. I. W. Smith, R. T. Waines.

Courses 2 and 8, IV Year; 3 hrs. laboratory per week, second term.

Problems worked out in the laboratory, designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for metallurgical apparatus, and mine machinery.

373. Machine Design. I. W. Smith.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

This is a continuation of subjects 363 and 357. It will involve the design of various machine elements and equipment including machine frames, hooks, hoisting equipment, crankshafts, gears (helical, herringbone, bevel, screw, and worm), springs, clutches, brakes, thin and thick wall vessels.

An introduction will be given to the study of vibration problems encountered in high speed engines and machines.

Text books: Design of Machine Elements—Spotts. Mechanical Vibrations—Thomson.

374. Machine Design Laboratories. I. W. Smith, R. T. Waines.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 4½ hrs. laboratory per week, second term.

Advanced laboratory work involves both analysis and design of machine elements, machine units, and complete machines. The

selection of problems is made with a view to giving the student as broad a coverage as possible and providing experience in combining of elements to form a machine of smooth and harmonious design. Some of this work will involve special shafting problems including graphical solutions, critical speeds, and multiple supports.

Work will be given in the Mechanical Laboratory on gauging and fine measurements, experimental stress analysis, vibration, and bearing testing.

375. Machine Design. G. E. Godfrey.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

Force analysis; mechanics, velocities, accelerations and inertia forces in machines; stress analysis; deflections; failure theory; fluctuating stress, and design of various machine elements including shafts, bearings, belts, gears, riveted and welded parts, etc.; also an introduction to speed fluctuation and vibrations.

Text book: Design of Machine Elements (third edition)—M. F. Spotts.

376. Machine Design Laboratory. R. T. Waines, G. E. Godfrey.

Course 4, IV Year; 3 hrs. per week, both terms.

Design and stress analysis of machine elements. In the laboratory, the student is given an opportunity to apply the subject material of the lectures to various machine design problems.

377. Machine Design. J. VandeVegte.

Course 5t, IV Year; 2 hrs. lectures per week, second term.

A series of lectures on design methods related to heat engines, including force analysis, speed fluctuation, flywheel design, governors, vibrations, high speed bearings, and thermal stress.

Reference books: Mechanism and Dynamics of Machinery—Mabie and Ocvirk. Analysis and Lubrication of Bearings—Shaw and Macks. Design of Machine Elements—Spotts.

378. Machine Design. R. T. Waines.

Course 6, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The design of various machine elements, particularly those likely to be met with in chemical plants, and an outline of the properties, production methods, and selection of materials used in machine equipment.

Reference books: Process Equipment Design—Hesse and Rushton. Principles of Machine Design—Berard, Waters and Phelps. Design of Machine Elements—Faires.

379. Machine Design Laboratory. I. W. Smith, R. T. Waines.

Course 6, IV Year; 3 hrs. laboratory per week, second term.

Problems worked out in the laboratory, designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical apparatus.

383. Mathematical Analysis. M. A. Dokainish, C. L. Proctor.

Courses 3 and 4, II Year; 1½ hrs. per week, both terms.

Solution of engineering problems by mathematical analysis, with particular reference to the work of course 2420.

386. Engineering Analysis. Staff in Mechanical Engineering.

Course 3, III Year; 1½ hrs. problems per week, first term; 3 hrs. problems per week, second term.

Exercises in reducing physical problems to analytical statements, with emphasis on the formulation of differential equations, the solutions of the mathematical problems involved, and the physical interpretation of these solutions; assessment of the validity of mathematical models.

Reference books: Engineering Analysis—verPlanck and Teare; Creative Engineering Analysis—Ryder.

387. Treatment of Technical Data. L. E. Jones.

Course 3, III Year; 2 hrs. lectures per week, and 3 hrs. problems per week, second term.

Presentation of data; approximate nature of technical data; role played by mathematics; general numerical methods including FORTRAN computer language; methods of organizing data for computation; methods of analyzing technical data; elements of curve-fitting and statistical treatment.

390. Applied Mathematics in Engineering. Staff in Mechanical Engineering.

Course 3, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term; 3 hrs. problems per week, both terms.

Dimensional analysis and similarity, numerical methods, relaxation techniques, approximate solutions, digital and analogue computation, including FORTRAN computer programming, introduction to statistics and operations research.

391. Elementary Control Theory. Staff in Mechanical Engineering.

Course 3, IV Year; 2 hrs. lectures per week, first term.

An introduction to the principles utilized in the analysis of linear control systems. Emphasis is also placed on the synthesis of mathematical models of simple systems, and the limitations inherently involved. Topics include stability criteria, characteristics of electrical, pneumatic and hydraulic control elements, and capabilities of feedback systems. A brief introduction to the problems arising from non-linear prototypes is included.

Recommended text: Automatic Control Engineering—Raven.

392. Elementary Control Theory Laboratory. Staff in Mechanical Engineering.

Course 3, IV Year; 3 hrs. laboratory per week, first term.

Problems and experiments related to subject 391 are dealt with.

393. Computational Methods. L. E. Jones.
Course 5t, IV Year; 1 hr. lecture per week, 3 hrs. problems per week, first term.
Practical extension of Subjects 2427 and 2428 to provide advanced computing experience with desk calculators and with analogue and digital computers. FORTRAN computer language will be studied in detail. Emphasis is placed on the economic use of available numerical procedures in the solution of engineering problems.

396. Industrial Management. B. M. M. Carpendale, P. B. Hughes.
Courses 3, 6, 7, IV Year; 1 hr. lecture per week, first term.
Introduction to principles of management and organization.
Subjects 3200 and 396 are combined in one examination.

DEPARTMENT OF INDUSTRIAL ENGINEERING

401. Operations Research I. The Staff in Industrial Engineering.
Course 4, IV Year; 2 hrs. lectures per week, both terms.
Methods of determining economic optima in industrial operations. Applications of mathematical techniques such as Lagrange multipliers, linear programming, non-linear programming, dynamic programming, to problems in production scheduling and sequencing, inventory control, transportation, equipment investment, utilization of scarce resources, and so on.
Recommended text: Concepts in Management Science, Donald J. Clough, Prentice-Hall Inc.

402. Operations Research I Laboratory. The Staff in Industrial Engineering.
Course 4, IV Year; 3 hrs. laboratory per week, both terms.
Practical work to accompany subject 401. Case studies and problem assignments.

403. Operations Research II. The staff in Industrial Engineering.
Course 4, IV Year; 2 hrs. lectures per week, second term.
Applications of probability theory and statistical analysis to problems in industrial operations. Markov theory applied to queuing, inventory, maintenance, and machine replacement problems. Statistical methods of estimation applied to the same problem areas.
Recommended text: Concepts in Management Science, Donald J. Clough, Prentice-Hall Inc.

404. Operations Research II Laboratory. The Staff in Industrial Engineering.
Course 4, IV Year; 3 hrs. laboratory per week, second term.
Practical work to accompany subject 403. Case studies and problem assignments.

405. Dynamics of Industrial Systems. D. J. Clough.
Course 4, IV Year; 2 hrs. lectures per week, first term.
The design and analysis of industrial systems, with particular emphasis on dynamic feedback models to simulate system behaviour. (Also see subject 406.)

406. Dynamics of Industrial Systems Laboratory. D. J. Clough.
Course 4, IV Year; 3 hrs. laboratory per week, first term.
The M.I.T. Dynamo compiler is used in conjunction with the I.B.M. 7090 computer to simulate the dynamic behaviour of the systems dealt with in subject 405.

407. Elementary Control Theory. A. Porter.
Course 4, IV Year; 2 hrs. lecture per week, both terms.
The dynamic behaviour of simple linear mechanical and electrical networks; weighting functions and transfer functions of linear elements; the principles of analogue and digital computers; introduction to Boolean Algebra and its applications; elements of information theory and its control implications; introduction to linear servomechanisms and manually operated control systems.

408. Elementary Control Theory Laboratory. A. Porter.
Course 4, IV Year; 3 hrs. laboratory per week, both terms.
Problems and laboratory experiments related to subject 407.

409. Current Developments in Industrial Engineering. The Staff in Industrial Engineering.
Course 4, IV Year; 2 hrs. lectures per week, second term.
A selection of topics emphasizing subjects of current technical interest in the field of Industrial Engineering. The interdisciplinary character of Industrial Engineering will guide the choice of specific treatment, perhaps from the fields of control theory, information theory, computer developments, management systems, biomedical problems, etc.

410. Current Developments Laboratory. The Staff in Industrial Engineering.
Course 4, IV Year; 2 hrs. laboratory per week, second term.
Readings in the topics of course 409 from the current technical literature will be assigned and two short essays will be required of each student.

411. Industrial Engineering Seminar.
Course 4, IV Year; 3 hrs. laboratory per week, second term.
Invited speakers, prominent in the Academic, Governmental, and Business communities, will conduct a series of talks followed by general discussion. An essay based on one of these sessions will be required.

412. Operations Research. A Porter, J. W. Abrams.
Course 2, III Year; 2 lectures per week, second term.
The history of operations research; introduction to statistical

mathematics; selected topics in O.R. methodology, e.g., replacement theory, inventory theory, transportation theory, queuing theory; introduction to electronic data processing.

413. Operations Research Laboratory. A. Porter, J. W. Abrams.
Course 2, III Year; 1½ hrs. per week, second term.
Problems and case histories associated with subject 412.

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

600. Chemistry. The Staff in Chemical Engineering.
Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.
Chemical theory, with industrial and engineering applications.

601. Chemical Laboratory. W. F. Graydon, J. Binkiewicz.
Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, I Year; 3 hrs. laboratory per week, both terms.
A laboratory course illustrating the fundamental laws of chemistry as dealt with in the lecture course, and providing an introduction to chemical analytical methods.

602. Chemistry. W. H. Burgess.
Course 5, I Year; 2 hrs. lectures per week, both terms.
Introductory physical chemistry: the gas laws, chemical equilibria, elementary solution chemistry, thermochemistry. Problems dealing with industrial and engineering applications.

605. Chemistry. W. F. Graydon, O. W. Berg.
Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.
Calculations based on systems in equilibrium; examples from pH, solubility, complex formation and phase equilibrium.

606. Analytical Chemistry Laboratory. W. F. Graydon, O. W. Berg.
Courses 2 and 9, II Year; 6 hrs. laboratory per week, first term.
Volumetric and gravimetric analysis.

607. Engineering Chemistry. W. H. Rapson, S. Sandler.
Courses 1, 3, and 4, II Year; 2 hrs. lectures per week, first term.
Corrosion and water-treatment; introduction to organic chemistry.

608. Physical Chemistry. R. W. Missen.
Course 5, II Year; 2 hrs. lectures per week, both terms.
A continuation of subject 602. Topics discussed include phase and reaction equilibrium, the latter following an introduction to chemical thermodynamics, reaction kinetics and electrochemistry.
Text book: Physical Chemistry—Daniels and Alberty—2nd edition.

609. Chemistry Laboratory. Staff in Chemical Engineering.
Course 5, II Year; 3 hrs. laboratory, alternate weeks, both terms.
Laboratory exercises to accompany subject 608.

610. Chemical Engineering Science Laboratory. Staff in Chemical Engineering.
Course 5, II Year (elective); 3 hrs. laboratory per week, second term.
An experimental introduction to physical rate processes. Electrical, fluid flow, heat transfer, and mass transfer systems with varied capacities are used to illustrate the dependence of the rate of transfer on driving force, resistance, etc.

613. Analytical Chemistry Laboratory. R. E. Jervis, C. P. Brockett.
Course 6, II Year.
This course commences on the Wednesday following the first Monday in September, and continues until the opening of the Fall Term. All the working time will be spent on systematic quantitative inorganic analysis.
Text book: Textbook of Inorganic Analysis—Kolthoff and Sandell.

614. Analytical Chemistry Laboratory. R. E. Jervis, C. P. Brockett.
Course 6, II Year; 9 hrs. laboratory per week, first term.
A continuation of Subject 613.

615. Analytical Chemistry. I. H. Spinner, R. E. Jervis.
Course 6, II Year; 2 hrs. lectures per week, first term.
Equilibrium considerations in quantitative analysis.

616. Industrial Chemistry. W. G. MacElhinney.
Course 6, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
Manufacture of acids, alkalis, and inorganic chemicals; water-treatment, corrosion, explosives.

617. Inorganic Chemistry. R. E. Jervis.
Courses 6 and 8, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
The constitution of matter and classification of the elements: systematic inorganic chemistry.

618. Organic Chemistry. J. G. Breckenridge.
Course 6, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
An introductory course in organic chemistry, with emphasis on reaction conditions and yields, and the industrial significance of certain compounds and reactions.
Text book: Systematic Organic Chemistry—Muldoon and Blake.

619. Chemical Engineering Science Laboratory. I. H. Spinner, C. P. Brockett, R. L. Hummel.

Course 6, II Year; 9 hrs. laboratory per week, second term.

Experiments illustrating the kinetic and equilibrium principles of chemical engineering. Instruction is given in glass-blowing, and mass and heat balance calculations.

One laboratory report per week.

625. Chemical Theory A. W. H. Burgess, W. F. Graydon.

Course 6, III Year; 1 hr. lecture per week, both terms.

Chemical kinetics; principles of adsorption and colloid chemistry.

626. Chemical Theory B. W. H. Burgess, W. F. Graydon.

Courses 5c and 6, III Year; 2 hrs. lectures per week, both terms.

Chemical thermodynamics, introductory to subject 655.

627. Chemical Laboratory. W. F. Graydon, Z. May.

Course 6, III Year; 6 hrs. laboratory per week, both terms.

A laboratory course to accompany subject 626.

628. Organic Chemistry. J. G. Breckenridge.

Course 6, III Year; 2 hrs. lectures per week, both terms.

A continuation of subject 618, dealing mainly with aromatic compounds.

629. Organic Chemistry Laboratory. W. H. Rapson, Z. May.

Course 6, III Year; 9 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A laboratory course accompanying subject 628.

630. Industrial Chemistry. W. G. MacElhinney, W. H. Rapson.

Course 6, III Year; 3 hrs. lectures per week, second term.

Chemical process industries, including petroleum, soap, sugar, pulp and paper, and fermentation industries. In preparation for this course, students will be expected to have read and to be thoroughly familiar with the following: Chemical Process Industries—Shreve: Chapters 29, 30, 31, 33, 34, 37.

631. Introduction to Mass and Heat Transfer. W. G. MacElhinney.

Course 6, III Year; 2 hrs. lectures per week, both terms; 3 hrs. laboratory per week, second term.

The fundamental theory and practice used in transfer operations in chemical engineering. Energy and mass transfer are considered in the study of the flow of fluids, fluidization of solids, heat transfer, and evaporation of solutions.

Text book: Principles of Unit Operation—Foust, Wenzel, Clump, Maus, and Andersen.

632. Public Speaking. W. H. Rapson, S. Sandler.

Course 6, III Year; 1 hr. per week, both terms.

640. Chemical Engineering Thermodynamics. W. F. Graydon.

Course 5c, III Year; 2 hrs. lectures per week, both terms.

A course in classical thermodynamics with problems in the field of applied chemistry and chemical engineering. Special emphasis is placed on chemical processes and compositional changes.

641. Chemical Engineering Rate Processes. O. Trass.

Course 5c, III Year; 3 hrs. lectures per week, both terms.

The kinetic theory of gases. Mechanisms and rates of homogeneous chemical reactions. Physical transport mechanisms and estimation of transport properties. Application to reaction kinetics and momentum, heat, and mass transfer.

642. Chemical Engineering Problems and Laboratory. Staff in Chemical Engineering.

Course 5c, III Year; 9 hrs. per week, both terms. Problems and laboratory experiments illustrating topics discussed in Subjects 640 and 641.

650. Mass Transfer Operations. O. Trass.

Courses 5c and 6, IV Year; 2 hrs. lectures per week, both terms.

The theory and practice of mass transfer operations in chemical engineering are discussed. Many problems in distillation, extraction, absorption, and other operations illustrate the course.

Text book: Mass Transfer Operations—R. E. Treybal.

651. Chemical Plant Design. R. W. Missen, J. W. Smith.

Course 6, IV Year; 1 hr. lecture per week first term; 3 hrs. laboratory per week, second term.

The lectures deal with selected topics in plant design: process design, plant location, economics. In the second term, process design calculations are done for a particular plant, ending with an economic evaluation of the process. If possible, a visit is made to a nearby operating plant to illustrate the work done in the laboratory.

Text book: Chemical Engineering Plant Design—Vilbrandt and Dryden.

Reference book: Chemical Engineering Cost Estimation—Aries and Newton.

652. Chemical Engineering Laboratory. R. L. Hummel, J. W. Smith, O. Trass.

Course 6, IV Year; 9 hrs. laboratory per week, first term.

A laboratory course to accompany subjects 631, 650, and 651. Bench and pilot plant experiments are carried out to study a variety of unit operations such as fluidization, heat transfer, evaporation, filtration, distillation, extraction, and absorption. Modern control instruments are discussed and operated.

One laboratory report per week.

653. Applied Mathematics in Chemical Engineering. R. W. Missen.

Course 6, IV Year; 3 hrs. laboratory per week, first term.

A problems course dealing with selected topics in dimensional, graphical and numerical methods, statistics and differential equations.

Reference books: Applied Statistics for Engineers—Volk; Applied Mathematics in Chemical Engineering—Mickley, Sherwood and Reed; Nomography and Empirical Equations—Davis.

654. Organic Chemistry. W. H. Rapson.

Course 6, IV Year; 1 hr. lecture per week, both terms.

The chemistry of natural and synthetic high-molecular-weight materials.

655. Chemical Engineering Thermodynamics and Kinetics. W. H. Burgess, W. F. Graydon.

Courses 5c and 6, IV Year; 2 hrs. lectures per week, both terms.

The application of thermodynamics and kinetics to problems in the field of chemical engineering.

660. Organic Chemistry. J. G. Breckenridge, I. H. Spinner.

Course 5c, IV Year; 2 hrs. lectures per week, both terms.

A lecture course in organic chemistry, concluding with a section on the chemistry of high polymers.

661. Organic Chemistry Laboratory. J. G. Breckenridge.

Course 5c, IV Year; 3 hrs. laboratory per week, first term.

A laboratory course to accompany subject 660.

662. Chemical Engineering Laboratory. Staff in Chemical Engineering.

Course 5c, IV Year; 6 hrs. laboratory per week, first term; 9 hrs. per week, second term.

Experiments illustrating the principles encountered in subjects 650 and 655.

670. Nuclear Engineering. D. G. Andrews, R. E. Jervis.

Course 5n, IV Year; 2 hrs. lectures and 3 hrs. laboratory per week, both terms.

Nuclear engineering aspects of: nuclear constitution and properties including cross-section, energetics, radioactivity, production and use of radio-isotopes, neutrons, slowing down, "age" theory, diffusion of thermal neutrons, fission.

The age and two-group theories of the reactor core. Reflected reactors (elementary treatment). Reactor kinetics, control and instrumentation.

Applications of heat transfer, fluid flow and stress analysis to the reactor core.

The measurement and control of radiation. Exposure of humans to radiation. Shielding techniques.

Nuclear engineering applications of nuclear and radio-chemistry.

DEPARTMENT OF ELECTRICAL ENGINEERING

700. Electricity. Staff in Electrical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism, including Kirchhoff's Laws and network theorems as applied to direct-current circuits, induced voltages, self and mutual inductance and an introduction to electric field concepts. The MKS system of units is used.

701. Electricity. Staff in Electrical Engineering.

Course 5, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism that is similar to subject 700 but adapted to the needs of Course 5.

710. Electric Circuits I. A. J. Kravetz.

Course 7, II Year; 3 hrs. lectures per week both terms; 2 hrs. computation, alternate weeks, both terms.

The relation of lumped parameters to field concepts, their physical realization and their variation with frequency. The representation of simple systems by lumped parameter circuits.

The analysis of linear circuits in the steady state with either direct or alternating sources. Loop and nodal methods. The elements of the topography of circuits. Coupled circuits. Response of circuits to variable frequency.

The transient response of simple linear circuits to suddenly applied sources and its relation to the steady state.

Three-phase circuits, balanced and unbalanced. Other polyphase circuits.

General network theorems, rigorously derived, including the transformation theorems.

711. Electric and Magnetic Fields. G. R. Slemon.

Course 7, II Year; 2 hrs. lectures per week, both terms; 2 hrs. computation, alternate weeks, both terms.

Electric and magnetic fields, forces and energies associated with charged and current-carrying conductors embedded in dielectric and magnetic media. Particle dynamics in electric and magnetic fields. Time-varying fields in conductors and insulators. Development of Maxwell's equations and interpretation in static and dynamic situations.

712. Electrical Measurements. H. A. Courtice.

Course 7, II Year; 2 hrs. lectures per week, second term.

Measurement of electrical quantities such as charge, potential difference, current, magnetic flux, energy and power. Measurement of electrical properties such as dielectric constant, permeability and conductivity. Measurement of resistance inductance and capacitance. Transducers for electrical measurement of mechanical, thermal and other physical quantities. Measurement

of alternating-current quantities in single phase and polyphase systems. Accuracy of measurement, curve fitting and treatment of measured data.

713. Electrical Laboratory.

Courses 3 and 4, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, both terms.

Appropriate laboratory experiments to accompany subjects 710, 712, and 714.

Courses 3 and 4. Six laboratory reports.

Course 7. Ten laboratory reports.

714. Electricity. H. A. Courtice.

Courses 3 and 4, II Year; 2 hrs. lectures per week, first term.

General principles and calculations of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power, and energy. The principles underlying commercial instruments are considered, together with the methods of calibration.

Reference books: Electrical Measurements—Laws. Basic Electrical Measurements—Stout.

715. Electric Circuits. A. J. Kravetz.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Circuits as models for physical devices. Kirchhoff's laws. Transient response of circuits. Steady state response of circuits with sinusoidal excitation. Network theorems. Topology and loop and nodal analysis of general circuits. Complex frequency analysis of circuits. Response of circuits to variable-frequency excitation. Analysis of polyphase circuits. Magnetically coupled circuits.

Text book: Circuit Analysis—Sabbagh.

716. Electric Circuits Laboratory.

Course 5, II Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory exercises to accompany subject 715.

Ten laboratory reports.

717. Alternating-Current Circuits. A. Straughen, G. O. Martens.

Courses 1 and 2, II Year; 2 hrs. lectures per week, first term.

Courses 3 and 4, II Year; 2 hrs. lectures per week, second term.

Fundamentals of alternating current, voltage and power. The analysis of series, parallel and three-phase circuits containing resistance, inductance and capacitance.

718. Alternating-Current Circuit Laboratory.

Courses 1 and 2, II Year; 3 hrs. laboratory alternate weeks, first term.

Courses 3 and 4, II Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 717.

719. Electrical Engineering. A. Straughen.

Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.

Basic d.c. measurements. Principles of single-phase and three-phase alternating currents. Elementary transients. Basic a.c. measurements. Principles of operation of d.c. and a.c. machines. Introduction to electronics.

Text book: Basic Electrical Engineering—Fitzgerald and Higginbotham.

720. Electrical Laboratory.

Courses 6 and 8, II Year; 3 hrs. laboratory per week, both terms.

Laboratory experiments to accompany subject 719.

Ten laboratory reports.

721. Applied Physics. F. B. Friend, J. R. Bird.

Course 1, II Year; 2 hrs. lectures per week, first term.

Course 7, II Year; 2 hrs. lectures per week, second term.

Correlating the physical principles of light, sound, and vibration with problems in engineering, emphasizing the importance of the analytical approach.

722. Applied Physics Laboratory. F. B. Friend, J. R. Bird.

Course 1, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, second term.

Supplementing subject 721.

Two laboratory reports per term.

723. Optics. F. B. Friend.

Courses 8 and 9, II Year; 1 hr. lecture per week, both terms.

Light, geometrical and physical optics and optical instruments, photography and photo micrography.

Reference book: A Second Course in Light—A. E. E. McKenzie.

724. Optics Laboratory. F. B. Friend, J. R. Bird.

Courses 8 and 9, II Year; 3 hrs. laboratory per week, both terms.

A laboratory course supplementing subject 723.

Two laboratory reports per term.

732. Applied Mathematics. P. P. Biringer.

Course 7, III Year; 2 hrs. lectures per week, both terms; 2 hrs. computation per week, both terms.

Vector analysis; functions of a complex variable, with applications; numerical analysis.

733. Electric Circuits II. V. G. Smith.

Course 7, III Year; 3 hrs. lectures per week, both terms.

Loop and nodal equations and methods of solution. Matrix notation. General theorems. Input and transfer admittances and impedances and dimensionless transfer functions. Symmetrical component analysis. Fourier series and integrals. Fourier and

Laplace transforms, direct and inverse. Operational methods applied to transients in linear systems. Dependent sources. Two-port networks. Electrical filters.

734. Electric Machinery I. G. R. Slemon.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Processes for the electro-mechanical conversion of energy. The fields, forces and torques in singly and multiply-excited magnetic systems. Theory, characteristics and applications of direct-current machines. Introduction to the dynamic behaviour and control of machines. Theory and applications of transformers. Introduction to rotating magnetic fields.

Reference books: Electric Machinery—Fitzgerald and Kingsley. Principles of Direct-Current Machines—Langsdorf. Direct-Current Machinery—Kloeffler, Brenneman, and Kerchner.

735. Electrical Laboratory.

Course 7, III Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises to accompany subjects 733 and 734.

736. Electrical Problems and Seminar.

Course 7, III Year; 4 hrs. per week, both terms.

Problems associated with courses 733, 734 and 737 are worked out under staff supervision. To provide practice in public speaking, one hour per week in the second term is devoted to short talks and discussions by the students on topics of their own choice.

737. Electronics. I. R. Dalton.

Course 7, III Year; 2 hrs. lectures per week, first term; 3 hrs. lectures per week, second term.

The behaviour of charged particles in electromagnetic fields. Electrical conduction in solids and gases. Electron emission. Semiconductor and vacuum devices. Electronic circuits.

738. Electronics Laboratory.

Courses 5e, 5m, 5p and 7, III Year; 3 hrs. laboratory per week, second term.

Laboratory experiments to accompany subjects 737 and 739.

Five laboratory reports.

739. Electronics. E. S. Lee.

Course 5 e, m, p, III Year; 2 hrs. lectures per week, both terms.

Introduction to electrodynamics and electrical conduction in solids and gases. Physical principles of electron devices. Linear and non-linear circuits using electron devices.

740. Electronics. I. R. Dalton.

Course 5, a, c, g, n, t, III Year; 2 hrs. lectures per week, both terms.

Physical principles of electronic devices and their applications in linear and non-linear circuits. Simple instrumentation and control systems.

741. Electronics Laboratory.

Courses 5a, 5c, 5g, 5n, 5t, III Year; 1½ hrs. laboratory per week, second term. Laboratory experiments to accompany subject 740.

Five laboratory reports.

742. Circuit Analysis. J. L. Yen.

Course 5e, III Year; 2 hrs. lectures per week, both terms.

Advanced analytical methods are used to derive general network theorems and to discuss general network properties. Complex wave forms, filters and unbalanced polyphase networks are considered in detail.

743. Electronics. P. E. Burke.

Courses 3 and 4, III Year; 2 hrs. lectures per week, first term. Course 1B, IV Year; 2hrs. lectures per week, second term.

Properties of vacuum tubes, gas tubes and semiconductors and their use as rectifiers and modulating devices. The use of circuit models containing ideal diodes and ideal controlled sources in analysing rectifiers and modulating devices.

744. Electronics Laboratory.

Courses 3 and 4, III Year; 3 hrs. laboratory alternate weeks, first term. Course 1B, IV Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercise to accompany subject 743.

Four laboratory reports.

747. Electric Machines. W. Janischewskyj.

Course 3, III Year; 2 hrs. lectures per week, both terms.

Operating characteristics, control, and applications of direct-current and alternating-current machines.

748. Electric Machines Laboratory.

Course 3, III Year; 3 hrs. laboratory alternate weeks, first term; 3 hrs. laboratory per week, second term.

Laboratory exercises to accompany subject 747.

Seven laboratory reports.

760. Electric Machines. W. Janischewskyj.

Course 4, IV Year; 2 hrs. lectures per week, first term.

Operating characteristics and applications of transformers and rotating electric machines.

761. Electric Machines Laboratory.

Course 4, IV Year; 3 hrs. laboratory per week, first term.

Laboratory exercises to accompany subject 760.

Four laboratory reports.

762. Electromagnetic Engineering. G. Sinclair.

Course 7, IV Year; 2 hrs. lectures per week, both terms; 2 hrs. computation alternate weeks, both terms.

Maxwell's equations, wave equations, retarded potentials, reciprocity theorem, lumped and distributed circuits, transmission

lines under transient and steady-state conditions, impedance charts, matching, waves in rectangular and circular waveguides, radiation from linear antennas, arrays, Friis transmission formula.

763. Electric Machinery II. G. F. Tracy.

Course 7, IV Year; 3 hrs. lectures per week, first term.

The theory and performance of generators, synchronous motors, single and polyphase induction motors.

Reference books: Principles of Alternating Current Machinery —Lawrence. Alternating Current Machines—Puchstein and Lloyd. Electrical Machinery—Fitzgerald and Kingsley.

764. Electric Machines Laboratory.

Course 7, IV Year; 3 hrs. laboratory per week, first term.

Laboratory exercises to accompany subject 763.

Four laboratory reports.

765. Control Systems. J. M. Ham.

Course 7, IV Year; 2 hrs. lectures per week, both terms.

A study of the analysis and synthesis of linear feedback control systems by means of differential equations and the Laplace transform. Topics covered include stability criteria, root-locus methods and compensation methods. An introductory study of non-linear systems is also made, including the use of describing-function and phase-plane methods of analysis.

766. Control Systems. J. M. Ham.

Courses 5e and 5n, IV Year; 2 hrs. lectures per week, both terms.

A course in linear and non-linear control systems that is similar to subject 765 but adapted to the needs of Courses 5e and 5n.

767. Control Systems Laboratory.

Course 5e, 5n and 7, IV Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory experiments and design problem periods to accompany subjects 765 and 766.

Four laboratory reports.

768. Electronic Circuits. J. E. Reid.

Courses 5e, 5m, 5p and 7, IV Year; 3 hrs. lectures per week, first term.

The basic principles of amplification, detection, modulation, demodulation, and radio-frequency power generation.

Reference book: Applied Electronics—Gray.

769. Electronic Circuits Laboratory.

Courses 5e, 5m, 5p and 7, IV Year; 3 hrs. laboratory per week, first term.

Experiments and problems to accompany subject 768.

Six laboratory reports.

770. Communication Systems. J. E. Reid.

Courses 5e and 7, IV Year; 3 hrs. lectures per week, second term.

A continuation of subject 768 covering theory and design of Class B and C amplifiers, power oscillators, crystal oscillators. Noise in communication circuits. Frequency conversion. Impedance transformation.

Reference book: Applied Electronics—Gray.

771. Communications Laboratory.

Courses 5e and 7, IV Year; 3 hrs. laboratory per week, second term.

Experiments and problems to accompany subjects 770 and 776. Seven laboratory reports.

772. Operational Methods. V. G. Smith.

Courses 5e, 5m, 5n, 5p and 5t, IV Year; 2 hrs. lectures per week, both terms.

Classical and Heaviside's operational methods are developed. Fourier's methods leading to the Laplace transforms are discussed and the close relationship between Laplace and Heaviside emphasized. Applications are chiefly to electric circuit analysis.

Reference books: Transformation Calculus and Electric Transients—Goldman. Electromagnetic Theory—Heaviside. Transients in Linear Systems—Gardner and Barnes. Simple Calculation of Electrical Transients—Carter.

773. Applied Electromagnetic Theory. G. Sinclair.

Courses 5e, 5g, 5n and 5p, IV Year; 2 hrs. lectures per week, both terms.

Electrostatics is reviewed and developed further to compute the capacities of engineering structures. Electromagnetism is reviewed and Maxwell's equations obtained. These are then applied in a study of plane waves, wave guides and antenna radiation.

774. Electric Machinery III. G. F. Tracy.

Course 7, IV Year; 2 hrs. lectures per week, second term.

A continuation of subject 763. Special types of alternating current motors, synchronous converters, single-phase induction motors, frequency changes, selsyn devices.

775. Electric Machines Laboratory.

Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 774.

Three laboratory reports.

776. Microwave Engineering. J. L. Yen.

Courses 5e and 7, IV Year; 2 hrs. lectures per week, second term.

The generation, processing, transmission and detection of microwaves and their applications.

777. Microwave Engineering Laboratory.
Courses 5e and 7, IV Year; 3 hrs. laboratory alternate weeks, second term.
Laboratory exercises to accompany subject 776.

779. Electric Power Systems. W. Janischewskyj.
Course 7, IV Year; 3 hrs. lectures per week, second term.
The theory associated with the economic generation, transmission and distribution of electrical energy in bulk and the control of power systems under normal and fault conditions.

780. Electric Power Systems Laboratory.
Course 7, IV Year; 3 hrs. laboratory exercises and problems per week, second term, to accompany subject 779.

792. Acoustics. V. L. Henderson.
Course 7, IV Year; 2 hrs. lectures per week, second term.
This subject deals with the properties of acoustical elements, particularly with their application in electrical sound systems.
Reference book: Elements of Acoustical Engineering—Olson.

793. Acoustics Laboratory. L. M. Steinberg.
Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.
Supplementing subject 792.
Three laboratory reports.

794. Illumination. Miss M. G. Currie, J. Chisvin.
Course 7, IV Year; 2 hrs. lectures per week, second term.
Illuminating Engineering dealing with the nature, measurement, and production of light and related radiations.
Theory of human vision; the design and application of lighting equipment for visual efficiency and comfort. Fundamentals of power supply.

795. Illumination Laboratory. Miss M. G. Currie, J. Chisvin.
Course 7, IV Year; 3 hrs. alternate weeks, second term.
Supplementing subject 794.
Three laboratory reports.

798. Vibration Engineering. V. L. Henderson.
Course 5t, IV Year; 1 hr. lecture per week, both terms.
Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

799. Vibration Laboratory. V. L. Henderson.
Course 5t, IV Year; 3 hrs. laboratory per week, second term.
A series of experiments designed to give familiarity with the

nature of vibrating systems and the causes, measurements, and control of vibration in engineering problems.

Three laboratory reports.

DEPARTMENT OF METALLURGICAL ENGINEERING

801. Metallurgy. The Staff in Metallurgy.

Course 8, II Year; 2 hrs. lectures per week, both terms.

An introductory course describing the theory and practice of metallurgical processes and operations.

802. Principles of Extractive Metallurgy. L. M. Pidgeon.

Course 8, III Year; 2 hrs. lectures per week, both terms.

A general discussion of the fundamental principles of extractive metallurgy with reference to the production of the more important metals.

803. Principles of Extractive Metallurgy Laboratory. H. U. Ross, S. N. Flengas.

Course 8, III Year; 3 hrs. laboratory per week, first term; 6 hrs. continuous laboratory per week, second term.

Experiments in pyrometry, furnaces, roasting, smelting, leaching, retorting, refining, electrolysis designed to illustrate the principles underlying these operations.

One laboratory report per week.

804. Metallurgy. H. U. Ross.

Courses 2 and 9, III Year; 1 hr. lecture per week, second term.

An introductory course describing the theory and practice of metallurgical processes and operations.

805. Non-Ferrous Extractive Metallurgy. L. M. Pidgeon.

Course 8, IV Year; 1 hr. lecture per week, both terms.

Extractive metallurgy of the non-ferrous metals, including electrometallurgy.

806. Extractive Metallurgy Laboratory. H. U. Ross, S. N. Flengas.

Course 8, IV Year; 6 hrs. continuous laboratory per week, first term.

A continuation of subject 803.

Four laboratory reports per term.

807. Ferrous Extractive Metallurgy. H. U. Ross.

Course 8, IV Year; 1 hr. lecture per week, both terms.

Extractive metallurgy of iron and steel.

808. Metallurgy. L. M. Pidgeon.

Courses 2 and 9, IV Year; 1 hr. lecture per week, both terms.

The extractive metallurgy of the common metals, together with the calculations necessary to understand metallurgical processes.

809. Metallurgy Laboratory. H. U. Ross, S. N. Flengas.
Course 2, IV Year; 6 hrs. continuous laboratory per week for one half of second term.
Similar to subject 803.
One laboratory report per week.

810. Metallurgical Thermodynamics I. G. B. Craig.
Course 8, III Year; 2 hrs. lectures per week, both terms.
The physico-chemical principles of metallurgy.

811. Metallurgical Problems Laboratory. H. U. Ross.
Course 8, II Year; 2 hrs. laboratory per week, second term.
Problems in chemistry and physical chemistry as applied to metallurgical processes relating to subject 801.

812. Metallurgical Problems Laboratory. H. U. Ross, S. N. Flengas.
Course 8, III Year; 4 hrs. laboratory per week, both terms.
Problems in chemistry, physical chemistry and thermodynamics as applied to metallurgical processes and operations relating to subjects 802 and 810.

813. Metallurgical Thermodynamics II. G. B. Craig.
Course 8, IV Year; 2 hrs. lectures per week, both terms.
A study of chemical equilibria at high temperatures in extractive metallurgy.

814. Metallurgical Problems Laboratory. S. N. Flengas.
Course 8, IV Year; 2 hrs. laboratory per week, both terms.
Problems relating to subjects 805, 807 and 813.

815. Physical Metallurgy. H. U. Ross.
Course 1, II Year; Course 2, IV Year; 2 hrs. lectures per week, second term.
A short course on the structure and mechanical properties of metals and alloys and on the influence of heat and mechanical treatment upon these properties. Reference is made particularly to steels and the more-important non-ferrous alloys. Welding of metals is also included.

816. Physical Metallurgy. U. Martius.
Courses 5a, 5c, 5g, 5n, 5t, III Year; 1 hr. lecture per week, both terms.
A short course in Physical Metallurgy; structure of metals and alloys; effects of mechanical distortion and heat treatment on structure; relation between structure and mechanical properties; and properties of some steels and non-ferrous alloys.

817. Physical Metallurgy. W. C. Winegard.
Courses 3 and 4, II Year; 2 hrs. lectures per week, both terms.
A general course in Physical Metallurgy, dealing with the structure of metals and alloys, with special reference to the ferrous

alloys of practical importance. The influence of mechanical deformation, heat treatment, and composition on the structure is considered, and the relation between the structure and mechanical properties is examined.

818. Physical Metallurgy Laboratory. W. C. Winegard.
Courses 3 and 4, II Year; 3 hrs. laboratory per week for six weeks, second term.
A practical course illustrating the principles dealt with in subject 817. Experiments are conducted on the heat-treatment of ferrous and non-ferrous alloys.

819. Physical Metallurgy. G. B. Craig.
Courses 5e and 7, III Year; 2 hrs. lectures per week, second term.
A short course in physical metallurgy which includes the structure of solids, the liquid-solid transformation, phase diagrams, defects in the solid state, the effect of stress and temperature on metals and the relationship between structure and properties. Commercial alloys are discussed in terms of the above topics.

820. Physical Metallurgy Laboratory. W. C. Winegard.
Courses 5e and 7, III Year; 1½ hrs. laboratory per week, second term.
Experiments are conducted to illustrate the essential features of subject 819. These include the examination of metals by metallographic and x-ray diffraction techniques.

821. Principles of Physical Metallurgy. G. B. Craig, W. C. Winegard.
Courses 5m and 8, III Year; 2 hrs. lectures per week, both terms.
A discussion of the structure of solids with particular reference to x-ray methods of investigation; the solidification of metals, and the plastic deformation of metals with reference to the dislocation theory.

822. Principles of Physical Metallurgy Laboratory. W. C. Winegard.
Courses 5m and 8, III Year; 3 hrs. laboratory per week, both terms.
Practical work relating to subject 821.

823. Physical Metallurgy. W. C. Winegard, G. B. Craig.
Courses 5m and 8, IV Year; 2 hrs. lectures per week, both terms.
A continuation of subject 821 in which the heat treatment of ferrous and non-ferrous alloys is discussed.

824. Physical Metallurgy Laboratory. W. C. Winegard.
Course 8, IV Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.
Practical work relating to subject 823.

825. Physical Metallurgy Laboratory. W. C. Winegard.
Course 5m, IV Year; 3 hrs. laboratory per week, second term.
Practical work relating to subject 823.

826. Physics of Metals Seminar. G. B. Craig, W. C. Winegard.

Course 5m, IV Year; 3 hrs. per week, both terms.

Each student prepares and presents seminars on topics concerning metal physics. The topics may include nucleation theory, dislocations, imperfections, electron theory, ferromagnetism, phase transformations, electrical properties, grain boundaries, metal surfaces, thermal properties, diffusion or any topic satisfactory to both staff and student.

827. Physics of Metals Laboratory. G. B. Craig and W. C. Winegard.

Course 5m, IV Year; 6 hrs. per week, first term; 12 hrs. per week, second term.

The design and execution of one or more experiments on a topic of current interest in the field of metal physics research.

INSTITUTE OF AEROPHYSICS

1030. Advanced Mechanics. H. S. Ribner.

Course 5, III Year; 2 hrs. lectures per week, both terms.

Mechanics of particles: fixed axes, rotating and moving axes, rectilinear motion of rockets, orbital dynamics. Mechanics of rigid bodies: fixed axes, body-attached axes (Euler's equations), gyroscopes. Dynamics of linear systems: free and forced oscillations, coupled systems, waves on a string, Rayleigh's method for continuous systems. Lagrange's equations. Introduction to wave mechanics.

Reference books: Introduction to Theoretical Physics—Page. Principles of Mechanics—Synge and Griffith.

1032. Fluid Mechanics. G. K. Korbacher, W. D. Baines, L. E. Jones, H. J. Leutheusser.

Courses 5a, 5c, 5n, 5t, III Year; 2 hrs. lectures per week, both terms.

Introductory concepts; vector analysis; inviscid flow, incompressible and compressible; viscous flow and turbulence; similitude and models; conduit systems; gravity effects; fluid machinery.

1033. Fluid Mechanics Laboratory. G. K. Korbacher, B. Etkin, J. B. French, L. E. Jones, W. D. Baines, H. J. Leutheusser.

Courses 5a, 5c, 5n, 5t, III Year; 3 hrs. laboratory per week, both terms.

Problems and experiments related to subject 1032.

1034. Mechanics of Solids and Structures. R. C. Tennyson.

Course 5a, III Year; 2 hrs. lectures per week, both terms.

A discussion of the structure of solids and the mechanics of their deformation. An introduction to the classical theories of elasticity and plasticity with application to the analysis of simple structures.

Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

1035. Mechanics of Solids and Structures Laboratory. R. C. Tennyson.
Course 5a, III Year; 3 hrs. laboratory per week, both terms.
Problems and experiments related to subject 1034.
Four laboratory reports.

1040. Aerodynamics. B. Etkin.
Course 5a, IV Year; 2 hrs. lectures per week, both terms.
Aerodynamics of flight: drag, propulsion, wing theory. Mechanics of flight: Performance of aircraft, stability and control of aircraft.
Reference books: Aerodynamics for Engineering Students—Houghton and Brock. Foundations of Aerodynamics—Kuethe and Schetzer. Flight Mechanics—1: Theory of Flight Paths—A. Miele. Dynamics of Flight—Stability and Control—Etkin.

1041. Aerodynamics Laboratory. B. Etkin, J. B. French.
Course 5a, IV Year; 3 hrs. laboratory per week, second term.
Problems and experiments related to subject 1040.
Five laboratory reports.

1042. Engineering Design. R. D. Hiscocks.
Course 5a, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
An introduction to the principles of design; the origin of a design requirement; loading, performance and other criteria; typical design specifications.
The process is examined by which the design is synthesized from the design specification and various other related data.
Selection of material; type of structure and fabrication technique.
Certain important aspects of design are examined in detail. These include the design of riveted, bolted, glued and welded joints, the design of cast and forged structural components, the fatigue life of structures and "fail safe" principles.
The course is illustrated throughout by reference to typical design problems, some of which are solved by the students.

1043. Engineering Design Laboratory. R. D. Hiscocks.
Course 5a, IV Year; 3 hrs. laboratory per week, both terms.
Design projects based on the lectures in subject 1042 are assigned. Design drawings, and engineering reports are prepared by the students.

1044. Mechanics of Solids and Structures. R. C. Tennyson.
Course 5a, IV Year; 1 hr. lecture per week, both terms.
A continuation of subject 1034 to a more advanced level; structural stability; thermal stresses; structural vibrations and wave propagation.
Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

1045. Mechanics of Solids and Structures Laboratory. R. C. Tennyson.
Course 5a, IV Year; 3 hrs. laboratory per week, first term.
Problems and experiments related to subject 1044.
Six laboratory reports.

1046. Plasmadynamics. J. H. deLeeuw.
Course 5a, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
Review of electric and magnetic fields. Derivation of Maxwell's equations. Thermodynamics and equations of motion of an electrically conductive medium. Simple examples of the influence of a magnetic field on the motion of an electrically conductive medium.

1047. Plasmadynamics Laboratory. J. H. deLeeuw, J. B. French.
Course 5a, IV Year; 3 hrs. laboratory alternate weeks, second term.
Problems and experiments based on the lecture material of subject 1046.
Two laboratory reports.

1048. Gasdynamics. I. I. Glass.
Courses 5a, 5n and 5t, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
Introductory thermodynamics of perfect and imperfect gases, equations of motion and their application to nozzles, diffusers and supersonic wind tunnels; expansion waves; normal, oblique and conical shock waves; skin friction and heat transfer in boundary layers and ducts; aerodynamic measurements.
Reference books: Elements of Gasdynamics—Liepmann and Roshko. Dynamics and Thermodynamics of Compressible Fluid Flow—Shapiro. An Introduction to Fluid Mechanics and Heat Transfer—Kay.

1049. Gasdynamics Laboratory. I. I. Glass, J. B. French.
Courses 5a, 5n, and 5t, IV Year; 3 hrs. laboratory alternate weeks, first term; 3 hrs. laboratory per week, second term.
Problems and experiments based on subject 1048 are given to illustrate principles of gas dynamics and the measurement of physical quantities.
Six laboratory reports.

1050. Transport Phenomena. J. B. French.
Course 5a, IV Year; 1 hr. lecture per week, both terms.
A fundamental treatment of selected phenomena in fluid dynamics in which the transport of momentum, mass and energy are the key underlying processes, i.e. dynamics of viscous fluids; boundary layers; turbulence; diffusion.
Reference book: Transport Phenomena—Bird, Stewart and Lightfoot.

DEPARTMENT OF PHILOSOPHY

2040. Philosophy of Science. Marcus Long, C. W. Webb.

Courses 1, 2, 3, 4, 5, 6, 7, 8, and 9, IV Year; 2 hrs. lectures per week, first term.

The relation between Science and Philosophy; an examination of the presuppositions of science and its basic concepts; alternative accounts of the nature of the universe with their implications for social and moral behaviour.

DEPARTMENT OF ENGLISH

2110. English.

All courses, I Year; 2 hrs. lectures per week, both terms.

A course in essay writing and the reading of literary works. Texts will include: Strunk and White, *The Elements of Style* (Brett-Macmillan), Harris and McDougall, *The Undergraduate Essay* (University of Toronto Press), Seat, *The University Reader* (American Book Co.); Shaw, *Saint Joan* (Penguin), Miller, *The Death of a Salesman* (Compass), a third play to be announced in September; Orwell, *1984* (Compass), Snow, *The Search* (New American Library), Walter M. Miller, *A Canticle for Leibowitz* (Bantam).

2140. English Literature.

All courses, IV Year; 1 hr. lecture per week, both terms.

A course in the drama, the novel and poetry based on the study of the following texts: Shaw, *Man and Superman* (Penguin); Shakespeare, *Othello* (Ginn); Twain, *Huckleberry Finn: Text, Sources and Criticism* (Harcourt Brace); Snow, *The New Men* (Penguin); Joyce, *Portrait of the Artist as a Young Man* (Compass); a third play to be announced in September; an anthology of poetry to be announced in September.

Students are expected to read the works named above during the summer preceding their entry into the Fourth Year. Term work will include assignments based on texts read during the summer, one substantial essay, and two class tests. Students who obtain a satisfactory term mark will not be required to write a final examination.

DEPARTMENT OF HISTORY

2330. Europe and the Modern World, 1500–1950. J. Estes.

All courses, III Year (elective); 2 hrs. lectures per week, both terms.

An introduction to the main currents of European history between 1500 and 1950, and of European relations with the extra-European world. The purpose of the course is not the accumulation of factual information but the attainment of some understanding of historical processes affecting the forms of political organization, economic activity, intellectual and social movements.

DEPARTMENT OF MATHEMATICS

2410. Calculus, Analytical Geometry and Algebra. C. Billigheimer, D. R. Breach, R. R. Burnside, P. B. Chapman, D. R. Miller, M. A. Stephens, P. Tan, J. R. Vanstone.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 3 hrs. lectures per week, both terms.

Real numbers and functions; limits, continuity and derivative functions; basic formulae of the differential calculus involving algebraic, trigonometric and exponential functions; applications to the sketching of curves, linear motion and rate problems. The definite integral and the fundamental theorem of the integral calculus, applied to the calculation of areas, volumes and work; techniques of integration, change of variable, integration by parts. Euclidean geometry in two and three dimensions; linear algebra, vector spaces, scalar products, matrices and determinants; eigenvalues and the reduction of the equations of quadric surfaces to standard forms.

2415. Algebra and Geometry. D. A. Clarke, Miss M. Wonenburger.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Complex numbers, elementary theory of equations, rational functions, vectors and matrices, coordinate systems, planes, lines, standard surfaces of the second degree, principal axes.

2416. Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Introduction of differential and integral calculus with applications; limits, power series, the exponential and logarithmic functions; trigonometric and hyperbolic functions and their inverses.

Text books: Calculus—Sherwood and Taylor. Introduction to the Calculus—Beatty and Jenkins.

2420. Calculus. B. Abrahamson, W. H. Greub, K. B. Ranger, P. G. Rooney.

Courses 1, 2, 3, 4, 6, 8, and 9, II Year; 2 hrs. lectures per week, both terms.

Continuation of subject 2410. Partial differentiation, multiple integration, series and Taylor's theorem, complex numbers and hyperbolic functions, first order differential equations and higher order linear differential equations with constant coefficients. Problems dealt with in the drafting room as outlined in subjects 138, 143, 144 and 383.

2421. Calculus and Differential Equations. R. A. Ross.

Course 7, II Year; 2 hrs. lectures per week, both terms. 2 hrs. computation per week, both terms.

The definite integral, expansion in series, ordinary differential equations, partial differentiation, multiple integration and an introduction to partial differential equations.

2423. Probability and Statistics. M. A. Stephens.

Course 4, II Year; 2 hrs. lectures per week, both terms.

Frequency distributions and probability laws; binomial, Poisson, and normal distributions and the treatment of samples drawn from them; tests of significance and confidence limits; control charts; introduction to the analysis of variance.

2424. Probability and Statistics Laboratory. M. A. Stephens.

Course 4, II Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises associated with the material of the companion lecture subjects.

2425. Differential Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Ordinary and partial differentiation, differentials, Taylor's theorem for functions of one or more variables, maxima and minima, transformations, convergence and uniform convergence, differential equations of the first order, linear differential equations with constant coefficients.

Text book: Advanced Calculus—Sokolnikoff.

2426. Integral Calculus. W. J. Webber, K. B. Ranger.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Methods of indefinite integration, definite integrals, multiple integrals, line and surface integrals, orthogonal functions.

Text book: Advanced Calculus—Sokolnikoff.

2427. Probability and Numerical Methods. R. Wormleighton.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Definition of probability; binomial, Poisson, and normal distributions; frequency; sampling distributions. Examples of estimation, hypothesis testing, control charts, regression, and analysis of variance.

2428. Mathematical Problems. W. J. R. Crosby, K. B. Ranger, D. K. Sen, W. J. Webber, R. Wormleighton.

Course 5, II Year; 3 hrs. problems per week, both terms.

The weekly sheet of prepared problems will be based on the content of courses 2425, 2426, and 2427 and will provide training in operating the routine processes of the Calculus and will illustrate these by applications in Numerical Methods, Mechanics and Geometry. Students will be given an opportunity to have their difficulties in these courses cleared up.

2430. Differential Equations. B. Brainerd, C. Billigheimer.

Courses 6 and 8, III Year; 1 hr. lecture per week, both terms.

First order equations solvable by quadratures, linear equations of first and second orders, linear equations with constant coefficients of higher order.

Text books: Elementary Differential Equations—Kells. Differential Equations—Reddick.

2432. Differential Equations. C. Davis, D. R. Miller.

Courses 3 and 4, III Year; 2 hrs. lectures per week, both terms.

First and second order ordinary differential equations, operational methods, variation of parameters, solution in series, Fourier series, Bessel and Legendre functions, the Laplace transform, applications to first and second order partial differential equations, applications to problems in fluid flow systems, heat conduction, vibrating systems and stress analysis.

2433. Numerical Analysis. M. A. Stephens.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Vectors, matrices, inversion of matrices, regression theory and calculations, elements of the design of experiments, theory of sampling.

2434. Numerical Analysis Laboratory. M. A. Stephens.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Practice in the numerical analysis methods and techniques dealt with in the lecture subject. Practical problems, as well as problems of a fundamental mathematical nature, will be covered.

2437. Theory of Functions. W. H. Greub.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

Complex numbers, limits and series, analytic functions, Cauchy's theorem, Taylor and Laurent series, singularities and their significance, analytic continuation, contour integration, conformal mapping of one plane region on another.

Text books: Functions of a Complex Variable—Phillips. Theory of Functions—Copson. Theory of Functions as Applied to Engineering Problems—Rothe, Ollendorf, and Pohlhausen. Introduction to Complex Variables and Applications—Churchill.

2438. Differential Equations. G. F. D. Duff.

Course 5, III Year; 1 hr. lecture and 1 hr. problem work per week, both terms.

First order equations solvable by quadratures, depression of the order, the linear equation with constant coefficients, operator methods, the linear partial differential equation, particular equations of the second order.

Text books: Differential Equations—Piaggio. Intermediate Differential Equations—Rainville. Fourier Series and Boundary Value Problems—Churchill.

2442. Statistics. P. Tan.

Course 8, IV Year; 2 hrs. lectures per week, second term.

An introduction to the statistical methods used in the analysis and control of production processes.

2445. Differential Equations of Mathematical Physics. G. F. D. Duff.
Course 5, IV Year; 2 hrs. lectures per week, both terms.
The underlying theory and important particular equations, including eigenvalues and eigenfunctions, Fourier series, spherical and cylindrical harmonics, vibration of strings, membranes, and rods, sound waves, water waves, equation of heat conduction.
Text books: Fourier series and Boundary Value Problems—Churchill. Modern Operational Mathematics in Engineering—Churchill. Partial Differential Equations of Mathematical Physics—Webster.

DEPARTMENT OF PHYSICS

2501. The Structure and Properties of Matter. J. N. P. Hume, R. L. Armstrong, A. D. May, J. D. Poll.
Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.
An introduction to the mechanical, electrical, magnetic, thermal and optical properties of matter in terms of atoms.

2502. Physics Laboratory. The Staff in Physics, Civil Engineering and Electrical Engineering.
Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year;
Twenty-four 3-hour periods of laboratory or problem work, twelve of which are devoted to experiments in the Physics Laboratory, six to experiments in the Electrical Laboratory and six to problems in Applied Mechanics.
All work must be completed within the assigned laboratory hours.

2511. Properties of Matter, Mechanics and Heat. D. G. Ivey.
Course 5, I Year; 3 hrs. lectures per week, both terms.
Text book: Mechanics, Heat and Sound—Sear.

2512. Physics Laboratory. D. G. Ivey, Miss K. M. Crossley and the staff in Physics.
Course 5, I Year; 3 hrs. laboratory per week, both terms; 1 hr. tutorial per week, both terms.
To accompany subject 2611.
Twelve laboratory reports.

2521. Physics. J. N. P. Hume.
Course 5, II Year; 3 hrs. lectures per week, both terms.
Fundamental theory of electricity and magnetism. Acoustic and electromagnetic waves. Interference, diffraction and polarization of light waves. Elementary atomic physics.

2522. Physics Laboratory. J. N. P. Hume.
Course 5, II Year; 3 hrs. laboratory per week, both terms.
To accompany subject 2621.

2531. Thermodynamics and Kinetic Theory. J. C. Stryland.

Courses 5a, 5e, 5g, 5m, 5n, 5p, 5t, III Year; 2 hrs. lectures per week, both terms.

The fundamental principles of thermodynamics, kinetic theory and statistical mechanics.

2532. Physics Laboratory. J. C. Stryland, H. P. Gush, R. D. Russell.

Courses 5a, 5e, 5g, 5m, 5n, 5p, 5t, III Year; 3 hrs. laboratory per week, both terms.

To accompany subjects 2631, 2633 and 2634.

Twelve laboratory reports.

2533. Atomic Structure and Quantum Physics. H. P. Gush, R. D. Russell.

Courses 5e, 5n, and 5p, III Year; 2 hrs. lectures per week, both terms.

Waves and particles; Schrodinger equation; harmonic oscillator, hydrogen atom, many-electron atoms; nuclear structure; radioactivity; interaction of radiation with matter.

2534. Physics of Solids and Fluids. F. S. Grant.

Courses 5e, 5g, 5m, 5p, III Year; 2 hrs. lectures per week, first term.

Elasticity, viscosity, equations of fluid motion, wave propagation, heat conduction, potential theory.

2535. Nuclear Physics. J. D. Prentice.

Courses 5n, III Year; 1 hr. lecture per week, both terms.

Neutron physics, nuclear radiation detection techniques, introduction to reactor theory and shielding problems, health physics.

2536. Physics of the Earth. J. T. Wilson.

Course 5g, III Year; 2 hrs. lectures per week, first term.

Introduction to gravitation, the figure of the Earth and isostasy, seismology and the internal constitution of the Earth; radioactivity, geothermal heat and the age of the Earth, tectonics of the Earth's crust, with special reference to geological aspects.

Text books: Physics and Geology—Jacobs, Russell and Wilson.

2541. Electromagnetic Radiation and Matter. H. L. Welsh.

Course 5p, IV Year; 2 hrs. lectures per week, both terms.

Propagation of electromagnetic waves, polarization, diffraction, interference, dispersion, scattering. Absorption, spontaneous and stimulated emission, Einstein coefficients. Coherence, maser and laser action.

2542. Physics Laboratory. The Staff in Physics.

Course 5n, IV Year; 6 hrs. laboratory per week, first term, and 3 hrs. per week, second term.

Courses 5c and 5p, IV Year; 6 hrs. laboratory per week, both terms.

To accompany the lecture subjects 2641, 2644, 2645 and 2646.

2543. Molecular Physics and Statistical Mechanics. E. J. Allin and J. D. Poll.

Course 5p, IV Year; 2 hrs. lectures per week both terms.

Quantum theory of rotation and vibration of molecules. Nuclear spins, symmetry, intensity rules, the hydrogen molecule, intermolecular forces. Boltzmann theory, transport equations, the Gibbs method, partition functions.

2544. Nuclear and High Energy Physics. K. G. McNeill and R. E. Azuma.

Courses 5n, 5p, IV Year; 2 hrs. lectures per week, both terms.

Nuclear forces, alpha-decay, beta-decay. Excited states of nuclei. Nuclear models. Reaction theory. Mesons, anti-particles, hyperons.

2545. Quantum Mechanics. J. Van Kranendonk.

Course 5p, IV Year; 2 hrs. lectures per week, both terms.

Schrodinger equation, eigenvalues and eigenfunctions. Angular momentum, Pauli spin theory, identical particles. Perturbation theory, transition probabilities. Scattering theory.

2546. Atomic Physics. Miss E. J. Allin, K. G. McNeill, H. L. Welsh.

Courses 5a, 5c, 5e, 5g, 5m and 5t, IV Year; 3 hrs. lectures per week, both terms.

Introduction to quantum theory, atomic, molecular and nuclear physics.

2561. Theory and Application of Geophysical Methods. F. S. Grant, R. D. Russell.

Course 5g, IV Year; 2 hrs. lectures per week, both terms.

A course on the mathematical theory of magnetic, electrical, seismic and gravitational methods in applied geophysics.

2562. Geophysics. F. S. Grant, G. F. West.

Course 5g, IV Year; 6 hrs. laboratory per week, both terms.

To accompany subject 2661.

2563. Physics of the Earth. D. York.

Course 5g, IV Year; 2 hrs. lectures per week, second term.

Physical theories of seismology and the internal constitution of the Earth, gravity and the figure of the Earth, temperature and thermal history, geomagnetism and physics of the upper atmosphere, glaciology, mechanical properties of the Earth's interior.

Text books: Physics and Geology—Jacobs, Russell and Wilson. The Earth—Jefferys.

2568. Exploration Geophysics. R. M. Farquhar.

Course 9, IV Year; 1 hr. lecture per week, both terms.

An introduction to the physical principles underlying the important methods of geophysical prospecting. Particular attention is given to the seismic, gravitational, magnetic and electromagnetic methods.

Text book: Introduction to Geophysical Prospecting—Dobrin.

2569. Geophysics. R. M. Farquhar.
Course 9, IV Year; 3 hrs. laboratory per week, both terms.
To accompany subject 2668.

DEPARTMENT OF CHEMISTRY

2621. Inorganic Chemistry. E. A. Robinson.
Course 5, II Year (elective); 2 hrs. lectures per week, both terms.
General inorganic chemistry, stereochemistry, and related physical measurements.

2622. Physical Chemistry. S. S. Danyluk.
Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.
An introductory course in chemical thermodynamics with emphasis on the thermodynamics of phase equilibria.

2623. Chemistry. A. D. Allen.
Course 7, II Year; 2 hrs. lectures per week, first term.
Inorganic Chemistry, with emphasis on the fundamental particles, atomic structure, the nature of the chemical bond and the general chemistry of the metallic elements.

2624. Analytical Chemistry Laboratory. F. E. Beamish.
Course 8, II Year; 4 hrs. laboratory per week, both terms.
Quantitative and qualitative analysis.

2631. Atomic and Molecular Structure. J. P. Valleau.
Course 5c, III Year; 2 hrs. lectures per week, both terms.
To follow course 2621. The application of wave mechanics to some problems of atomic and molecular structure, and an introduction to statistical thermodynamics.

2632. Electrochemistry. J. P. Valleau.
Courses 6 and 8, IV Year; 2 hrs. lectures per week, first term.
Principles of electrochemistry and their application to industrial problems.

2633. Electrochemistry Laboratory. J. P. Valleau.
Courses 6 and 8, IV Year; 18 hrs. first term.
Quantitative measurements to accompany subject 2632. Six laboratory reports required.

DEPARTMENT OF POLITICAL ECONOMY

2720. Economics. D. F. Forster, B. Bixley, A. Kruger, D. Nowlan.
All courses, II Year; 2 hrs. lectures per week, both terms.
An introduction to the study of Economics with special reference to the problems of the Canadian economy.

2730. Introduction to Political Science. P. Bishop, R. Gregor.
All courses, III Year (elective); 2 hrs. lectures per week, both terms.
An introduction to the study of government with special reference to the problems of Canadian government.

2734. Accounting. W. C. Hebdon.
Course 4, III Year; 2 hrs. lectures per week, both terms.
Basic accounting principles and procedures, the preparation and interpretation of financial statements, cost accounting, and the use of accounting as a means of control.

DEPARTMENT OF PSYCHOLOGY

2840. Industrial Psychology. W. Line.
Course 4, IV Year; 2 hrs. lectures per week, second term. (Not offered in the session 1963–64.)
A series of lectures and discussions on human relations, with the focus on some of the current problems in a developing industrial culture.

DEPARTMENT OF GEOLOGICAL SCIENCES

2900. Physical Geology. P. A. Peach.
Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.
Course 5g, III Year; see subject 2902.
An Introduction to the study of geology and mineralogy.
Reference books: Principles of Geology—Gilluly, Waters and Woodford *or* Physical Geology—Leet and Judson.

2901. Physical Geology Laboratory.
Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. laboratory and 1 hr. tutorial per week, first term.
A laboratory course to accompany subject 2900.

2902. Physical Geology. P. A. Peach.
Course 5g, III Year.
A reading course during the summer preceding the III Year. A special examination will be held early in October. Students who do not pass this examination will be required to write the examination in Subject 2900 in January.

2904. Geology of Canada. F. W. Beales.
Course 9, IV Year; 1 hr. lecture per week, both terms.
A reading survey of the physiography, historical geology, major structural features, and mineral deposits of the country.

2906. Engineering Geology. W. H. Gross.
Course 1, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
An introduction course in geology with special reference to engineering problems.

2907. Engineering Geology Laboratory.
Course 1, II Year; 1 hr. per week, first term; 2 hrs. per week, second term.
Specimens, maps and sections to accompany subject 2906.

2910. Mineralogy and Lithology. D. H. Gorman, P. A. Peach.
Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. lectures per week, both terms.
A study of crystallography, descriptive and determinative mineralogy, and the common rocks.
Reference book: An Introduction to the Study of Minerals—Rogers.

2911. Mineralogy and Lithology Laboratory. D. H. Gorman, P. A. Peach.
Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. per week, both terms.
Practice in identifying minerals and rocks.

2913. Descriptive Mineralogy. D. H. Gorman.
Course 9, III Year; 2 hrs. laboratory per week, both terms.
Continuation of the mineralogy of subject 2910.

2915. Ore Microscopy. D. H. Gorman.
Course 9, III Year; 3 hrs. laboratory per week, second term.
Identification of minerals in polished sections.

2916. Crystallography. E. W. Nuffield.
Courses 5m, 5p and 8, III Year; 1 hr. lecture per week, both terms.
The modern concept of crystals; symmetry elements; derivation of space lattices, classes, forms, indices.

2918. X-Ray Crystallography. E. W. Nuffield.
Course 5m, IV Year; 2 hrs. lectures per week, second term.
X-ray diffraction methods and their application in the study of crystalline materials.

2920. Petrology. P. A. Peach.
Course 9, III Year; 3 hrs. lectures per week, first term; 2 hrs. lectures per week, second term.
Microscopic character of the rock-forming minerals in thin sections, and description and classification of rocks.

2921. Petrography Laboratory. P. A. Peach.
Course 9, III Year; 2 hrs. per week, both terms.
Microscopic petrography, to accompany subject 2920.
Text book: Optical Mineralogy—Rogers and Kerr.
One laboratory report.

2924. Elementary Geochemistry. F. G. Smith.
Course 9, III Year; 2 hrs. lectures per week, both terms.
Covering the periodic table, distribution of the elements, states of matter, phase diagrams, natural hydrothermal solutions, weathering, and geochemical cycles.

2930. Historical and Stratigraphical Geology. F. W. Beales.
Courses 2 and 9, II Year; 2 hrs. lectures and 1 hr. tutorial per week, second term.
Study of the principles of stratigraphy and historical geology since Precambrian times.

2931. Historical and Stratigraphical Geology Laboratory. F. W. Beales.
Course 9, II Year; 2 hrs. per week, second term.
Laboratory work to illustrate subject 2930.

2932. Stratigraphy and Sedimentation. F. W. Beales.
Course 9, III Year; 2 hrs. lectures per week, first term.
Description, classification and interpretation of sedimentary rocks and rock units.

2934. Glacial Geology and Ground Water. R. E. Deane.
Course 2, IV Year; 1 hr. lecture per week, both terms.
Pleistocene Geology. The formation and distribution of the drift deposits of North America, with emphasis on their economic importance.

2936. Pleistocene Geology. R. E. Deane.
Courses 1D and 9, IV Year; 2 hrs. lecture per week, both terms.
Study of the Pleistocene Deposits of North America and Europe.

2938. Palaeontology. M. A. Fritz.
Course 9, III Year; 2 hrs. lecture per week, both terms.

2939. Palaeontology Laboratory. M. A. Fritz.
Course 9, III Year; 2 hrs. per week, both terms.
Six laboratory reports.

2944. Precambrian Geology. W. W. Moorhouse.
Courses 2, 5g, and 9, IV Year; 2 hrs. lecture per week, first term.
Precambrian formations of Canada—their rocks, distribution, relationships and economic features.

2945. Precambrian Geology Laboratory. W. W. Moorhouse.
Courses 2 and 5g, IV Year; 1 hr. laboratory per week, first term.
Course 9, IV Year; 3 hrs. laboratory per week, both terms.
To accompany subject 2944.

2950. Structural Geology. J. B. Currie.
Courses 2, 5g and 9, III Year; 1 hr. lecture per week, both terms.
Structures caused by the deformation of the earth's crust.
Text book: Structural Geology—Billings.

2951. Structural Geology Laboratory. J. B. Currie.

Courses 2, 5g and 9, III Year; 3 hrs. per week, both terms.

Work with geological maps of folded and faulted areas, structural sections, and the solution of problems relating to folding and faulting.

Laboratory course to accompany subject 2950.

2960. Mineral Deposits. W. H. Gross.

Courses 2, 5g and 9, IV Year; 2 hrs. lecture per week, both terms.

Theories of origin of mineral deposits and description of world's important mineral deposits.

2961. Mineral Deposits Laboratory. W. H. Gross.

Course 9, IV Year; 3 hrs. per week, second term.

2964. Petroleum Geology. J. B. Currie.

Courses 5g and 9, IV Year; 2 hrs. lecture per week, both terms.

The origin, nature, and occurrence of petroleum and natural gas deposits and the extraction of these substances from the earth.

2965. Petroleum Geology Laboratory. J. B. Currie.

Courses 5g and 9, IV Year; 3 hrs. per week, second term.

Accompanying subject 2964.

2968. Mining Geology. G. B. Langford.

Courses 2 and 9, IV Year; 2 hrs. lecture per week, second term.

A course dealing with the application of geology to mining.

Reference book: Mining Geology—McKinstry.

2969. Mining Geology Laboratory. G. B. Langford.

Course 9, IV Year; 3 hrs. per week, first term.

Two laboratory reports.

2981. Stratigraphic and Sedimentary Field Work. F. W. Beales.

Course 9, III Year; 2 hrs. per week, first term.

Field work along the Niagara Escarpment.

Three laboratory reports.

2983. Petrological, Mineralogical and Structural Field Work.

Course 2, III Year: 7 days.

Course 9, III Year: 14 days.

A field camp in the Tweed area of Ontario. Laboratory work in the field complementing subjects 2920 and 2951.

2985. Geological Field Trips (Glacial Geology).

Courses 2 and 9, IV Year. Two trips.

During the fall trips will be made to points of interest near Toronto.

2987. Geological Field Trips (Economic and Mining).

Course 9, IV Year. Two trips, each ½ day.

Trip to gypsum mine and cement plant.

SCHOOL OF BUSINESS

3030. Industrial Management. T. C. Graham.

Course 4, III Year; 2 hrs. lectures per week, both terms.

A study of the factors involved in the production and distribution of products or services. Consideration will be given to the general concepts of management, organization, leadership and industrial relations but major emphasis will be on work simplification, time and motion study, wage administration and controls of production, quality and costs.

3031. Industrial Management Laboratory. T. C. Graham.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Cases and problems to accompany the lecture subject.

DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION

3110. Physical Education.

All courses, I Year.

By order of the Board of Governors each first year student must register for, and satisfactorily complete, the University requirement in Physical Education. This requirement includes a medical examination by the University Health Service. Each year of failure to fulfil the regulations renders the student liable to a special fee of $50.00.

Physical Education credits may be earned by participation in intercollegiate and intramural sports, swimming, water safety, and instructional classes.

Exemptions: (1) one year's satisfactory standing in physical education at this or any other University (2) if age is 30 years or more (3) ex-military service (4) completion of one year's course in the U.N.T.D., C.O.T.C. or U.R.T.P. (5) exemption by the University Health Service (6) special consideration.

INSTITUTE OF COMPUTER SCIENCE

3331. Engineering Data Processing. C. C. Gotlieb, J. Csima.

Course 4, III Year; 2 hrs. lectures per week, second term. Course 4, IV Year; 2 hrs. lectures per week, second term (Session 1963–64 only).

A course in programming and coding for the digital computer.

3332. Engineering Data Processing Laboratory. C. C. Gotlieb, J. Csima.

Course 4, IV Year; 3 hrs. laboratory per week, second term (Session 1963–64 only). Course 4, III Year; 3 hrs. laboratory per week, second term.

Practical work to accompany subject 3331.

SPECIAL LECTURERS

3440. Engineering Law. W. O. Chris. Miller.

Courses 1, 3, 4, 6, and 7, IV Year; 1 hr. lecture per week, first term.

A subject designed to co-ordinate the practice of engineering and law. Consideration is given to the characteristics, advantages and disadvantages of companies, partnerships and sole proprietorships, the promotion, organization and financing of companies, the duties of employees to employers, the duties and liabilities of engineers, statutes applicable to engineering works, professional engineering associations, construction contracts, workmen's compensation, trade unions and industrial disputes.

Text book: Engineering Law—Laidlaw and Young.

SCHOOL OF ARCHITECTURE

3540. Town and Regional Planning. M. Hugo-Brunt.

Course 1B, IV Year; 1 hr. lecture per week, both terms.

Town Planning principles both past and present. The role of the planner, the plan, local legislation, the central area, the neighbourhood, subdivision, the suburb, open space and the region, housing, road layout, services, industry, commerce and special uses.

3541. Town and Regional Planning. M. Hugo-Brunt.

Course 1B, IV Year; 3 hrs. practical work per week, both terms.

Studio work including exercises in survey, research and analysis, subdivision layout, and urban analysis. These are related to subject 219.

SECTION IX. EXAMINATIONS

ANNUAL EXAMINATIONS

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in subjects completed during the first term.

3. Promotions from one year to another are made on the results of term work and the annual examinations. A student proceeding to a degree must pass in all term work and examinations in all subjects of his course, and at the periods arranged by the Council.

4. The pass marks required on written examinations and laboratory work in each subject is 50% and a student must obtain a weighted average of 60% in order to pass in the work of the year. (In the First Year of the course in Engineering Science, an average of 66% or over is required for promotion in that course. For special regulations concerning Engineering Science, see page 45 of this Calendar.) He shall be required to pass a supplemental examination in each subject in which he obtains less than 50%. Subjects will be weighted according to the number of hours devoted to them, the hours assigned to laboratory subjects being given one half the weight of those in lecture subjects.

5. Honours and scholarships will be awarded upon the basis of the weighted average.

6. Honours will be awarded to a student, who at the Annual Examinations passes in all written and laboratory subjects and who also obtains a weighted average of 75% on the work of the year.

7. Honour graduate standing will be granted to those who obtain honours in the final year and in one previous year.

8. A student who fails in the work of any year will be permitted, unless otherwise ineligible, to register in a subsequent session for the purpose of repeating the year, subject to the following conditions:

(a) Only one such repetition will be allowed in the student's entire undergraduate course. A failure in an engineering course at any other institution will be counted in the same way as a failure at this university.

(b) During any such repetition, the full programme of prescribed instruction must be taken.

(c) Second, Third, or Fourth Year work may be repeated in the session immediately following that in which the failure occurs.

(d) A student who fails in the work of the First Year but who obtained an average of 55% or over will, provided he is otherwise eligible, be allowed to repeat the work of the year in the following Session. All other students who fail in the work of the First Year must remain out for one Session before re-applying. If a student withdraws on or before 15th February he may re-apply for admission the following Session.

Any student re-applying for admission to the First Year must

file a new application (as outlined in Paragraph 6, Section V) with the Registrar of the University.

9. A student who has twice failed the work of his first year at this or another university shall not be granted admission to any course.

10. A student whose attendance at lectures or laboratories, or whose work, is deemed by the Council of the Faculty in which he is registered, to be unsatisfactory, may have his registration cancelled at any time by the Council of the Faculty.

11. A student should submit to Council immediately after its occurrence, evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

12. A student will not be allowed to write any examinations if he has not paid all fees and dues for which he is liable at that time.

SUPPLEMENTAL EXAMINATIONS

1. The supplemental written examinations will begin on August 12, 1963. Application (on the prescribed form) to take such examinations, including practical ones, must be received from the candidate by the Secretary of the Faculty not later than July 10, and the fee named in Sec. VI, para. 11, received by the Chief Accountant not later than July 31. Council reserves the right to reject applications of, or impose penalties upon, those failing to comply with these requirements.

2. A candidate desiring to write a supplemental examination at the time of the annual examinations must submit an application to the Secretary, and pay the supplemental examination fee to the Chief Accountant, not later than December 1 for the January examinations and not later than March 15 for the April examinations.

3. Except under very exceptional circumstances, pass standing must be obtained in all written supplementals before entering the next higher year, and in all laboratory supplementals before or during the Session of the next higher year as may be required by the Department concerned.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by the order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

EXTRA-CURRICULAR ACTIVITIES AND ACADEMIC CREDIT

It is in general desirable for students to engage to a reasonable extent in extra-curricular activities in order that they may not become too narrowly professional in interests and outlook, but it will be obvious that no academic credit or consideration can be given for such activities. Some offices in student organizations require quite large amounts of time for the proper performance of the duties connected with them, and it is therefore strongly recommended that students, particularly those whose academic records are not high, consult a senior member of Staff before allowing themselves to be nominated for such offices.

SECTION X. MEDALS, PRIZES, SCHOLARSHIPS, BURSARIES AND FELLOWSHIPS

Through the generosity of friends of the University, governments and commercial organizations, encouragement has been given to both undergraduate and graduate work in the various branches of engineering studies by establishing the following scholarships, prizes, bursaries, and medals.

Matriculation students are advised to consult the University of Toronto Calendar of Admission Awards for complete details of awards available to students entering this Faculty.

Where it is necessary to make application for an award it is so stated in the description and particulars are given as to how the application should be made. In all other cases the award is made on the recommendation of the Faculty Council and no application is necessary.

In order to be eligible for a medal, prize, scholarship, bursary, fellowship or other awards granted solely upon standing obtained at an annual or special examination or upon an essay, or term work, or other academic rating, a candidate must obtain honours at such annual or special examination or upon such essay, term work, or other academic rating unless the terms of the award or medal specify that standing lower than honours may be accepted.

When an award or medal is granted upon standing obtained on part of the work of any academic year the candidate must obtain standing but need not obtain honours in the work of the academic year as a whole, provided he obtains honours in the part concerned, unless the terms of the award or medal specify otherwise.

No medal, prize, scholarship, bursary, fellowship or other award will be granted to a candidate who is conditioned in any subject at an annual examination or in Physical Education unless the terms of the award or medal specify otherwise.

A candidate will not be permitted to receive more than one award in a session unless the statute establishing each of the awards concerned or the Calendar specifies otherwise. Only one of those marked by an asterisk may be held in any one year. A candidate who would, but for this provision, have received more than one award may have his name so published in the class lists.

A candidate who has spent two sessions in any year of an undergraduate course is not eligible to compete for any award at the annual examinations of that year.

Medals, after they have been suitably engraved, will be given without delay to the winners or forwarded to them by registered mail.

Awards granted to members of graduating classes other than awards for graduate study and research, will be paid in one instalment as soon as possible after the granting of the awards.

All other awards will be paid (i) if of the value of $100 or less, in one instalment on November 20 and (ii) if of the value of more than $100 in two equal instalments, the first on November 20 and the second on

January 20, in the session following the granting of the awards provided that no payment is made to a candidate (*a*) who is not in regular attendance upon lectures and laboratory classes in the Faculty, or if the Calendar so specifies, in the course in which the award is established or granted (*b*) who does not present at the Chief Accountant's Office before each payment a certificate of attendance upon lecture and laboratory classes signed by two senior members of the staff.

The Senate may, on the recommendation of the Faculty, pennit a candidate to whom an award has been granted to postpone attendance upon lectures and laboratory classes for one year. Further postponement may be permitted on application.

Name	Amount	Application required	Available only to a limited group or single course	See page
AVAILABLE TO STUDENTS ENTERING THE FIRST YEAR				
Alumni Association War Memorial Scholarships......	$500	Yes	No	166
Alcan Scholarship............	$500	Yes	No	140
J. P. Bickell Foundation Scholarships..............	$500	Yes	No	143
J. W. Billes Admission Scholarships..............	—	Yes	No	144
Dominion Magnesium Limited Bursary..................	$400	Yes	Yes	145
Dominion-Provincial Student Aid Bursaries, Type A......	—	Yes	No	146
Engineering Alumni Admission Bursaries.	—	Yes	No	147
Engineering Alumni Admission Scholarship................	$500	Yes	No	147
Grabill Admission Scholarship................	$400	Yes	No	149
Hagarty Memorial Scholarship.	$60	Yes	Yes	149
The Murray Calder Hendry Scholarship................	$500	Yes	No	150
Inco Scholarship	$300 + Fees	Yes	No.	151
The Leonard Foundation Scholarships........	—	Yes	Yes	152
J. Edgar McAllister Foundation	—	Yes	Yes	153
O.H.A. War Memorial Scholarship................	$200	Yes	Yes	157
Ontario Chapter American Society for Metals Bursaries (2)...............	$400	Yes	Yes	141

Name	Amount	Application required	Available only to a limited group or single course	See page
A.P.E.O. Admission Scholarship	$500	Yes	No	159
Helen E. Rogers Admission Scholarships......	—	Yes	Yes	161
Simpson-Sears Limited (Northern Ontario) Scholarship.....................	$100	Yes	Yes	162
Smith and Stone Limited Bursaries..................	$150	Yes	Yes	163
Walter Sterling Admission Scholarships...............	—	Yes	No	164
Students' Administrative Council Admission Scholarship....	$300	Yes	Yes	164
U.T.S. Engineering Scholarship.	$250	Yes	Yes	166
Wallberg Admission Scholarships (2)..................	$500	Yes	No	166
Available to Students Completing the First Year				
American Society for Metals Foundation for Education and Research Scholarship....	$500	No	Yes	141
Atkinson Incourse Bursaries...	—	Yes	No.	142
Babb Bursary Fund..........	—	Yes	Yes	142
Baptie Scholarship............	—	No	Yes	142
Canadian Bechtel Limited Bursaries.................	—	Yes	No	143
J. P. Bickell Foundation Scholarships...............	—	No	No	144
T. H. Bickle Prize............	$30	No	Yes	144
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	146
*John M. Empey Scholarship...	$100	No	No	146
*Hydro-Electric Power Commission Scholarship.........	$300	No	No	151
I.B.M.—Thomas J. Watson Memorial Bursary Fund.....	—	Yes	No	151
Inco Scholarship.............	—	Yes	Yes	151
Johnson's Wax Scholarship....	$600	No	Yes	151
Kimberly-Clark Scholarship ...	$500	No	No	152
John Wolfe McColl Awards....	—	Yes	No.	153
Garnet W. McKee-Lachlan Gilchrist Scholarship in Engineering Physics........	$60	No	Yes	154

Name	Amount	Application required	Available only to a limited group or single course	See page
MacLennan-LacLeod Memorial Prize....	$25	No	No	155
*Marsland Engineering Ltd. Scholarship...............	$250	No	Yes	156
Orenda Engines Scholarship ...	$500	No	Yes	158
*Paulin Memorial Scholarship..	$425	No	Yes	158
Procter and Gamble Bursary..	—	Yes	No	159
*Professional Engineers Scholarship	$250	No	Yes	159
*Ransom Scholarship in Chemical Engineering.......	$150	No	Yes	160
Frederick W. Schumacher Scholarship................	—	Yes	Yes	162
S. Ubukata Fund............	—	Yes	Yes	165
University Naval Training Division Bursaries..........	$100	Yes	Yes	166
University of Toronto General Bursaries.................	—	Yes	No	166
*Wallberg Undergraduate Scholarships (2)...........	$500	No	No	167
AVAILABLE TO STUDENTS COMPLETING THE SECOND YEAR				
*Harvey Aggett Memorial Scholarship	$75	No	No	140
Ardagh Scholarship...........	$220	No	Yes	142
Automotive Transport Association Bursary........	—	Yes	No	142
Babb Bursary Fund..........	—	Yes	Yes	142
Canadian Bechtel Limited Bursaries..................	$1200	Yes	No	143
J. P. Bickell Foundation Bursaries..................	—	Yes	Yes	144
J. P. Bickell Foundation Scholarships	—	No	Yes	143
T. H. Bickle Prize............	$30	No	Yes	144
Carveth Metallurgical Ltd. Bursary..................	$500	Yes	Yes	145
Dominion-Provincial Student-Aid Bursaries.............	—	Yes	No	146
*John M. Empey Scholarship...	$100	No	No	146
J. A. Findlay Scholarship.. ..	—	No	Yes	148

Name	Amount	Application required	Available only to a limited group or single course	See page
Hugh Gall Award	$140	Yes	No	148
*Hydro-Electric Power Commission Scholarship	$300	No	No	151
I.B.M.—Thomas J. Watson Memorial Bursary Fund	—	Yes	No	151
Johnson's Wax Scholarship	$600	No	Yes	151
The Kennecott Copper Award in Industrial Engineering	$1000	Yes	Yes	152
Kimberly-Clark Scholarship	$500	No	No	152
The Lever Brothers Scholarships	$300	No	Yes	152
*Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarships	—	No	Yes	154
Charles Gordon Manning Prize	—	No	No	155
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	156
W. G. Millar Memorial Scholarship	$250	Yes	Yes	156
Mobil Oil of Canada Limited Scholarship	$400	No	Yes	156
James L. Morris Memorial Prize	$125	No	Yes	157
Northern Electric Undergraduate Scholarship	$500	No	Yes	157
Orenda Engines Scholarship	$500	No	Yes	158
*Spruce Falls Power and Paper Company Scholarships	$400	No	No	163
William Storrie Memorial Scholarship	$100	No	Yes	164
*Professional Engineers Scholarship	$250	No	Yes	159
*Rhodes Scholarship	£400	Yes	No	160
Scottish Rite Masons Bursary	$400	Yes	Yes	162
Frederick W. Schumacher Scholarship	—	Yes	Yes	162
Edith Tyrrell Memorial Bursary	$500	Yes	Yes	165
University of Toronto General Bursaries	—	Yes	No	166
*Wallberg Undergraduate Scholarships	500	No	No	167
*William R. Worthington Memorial Scholarship	$400	No	Yes	167

Name	Amount	Application required	Available only to a limited group or single course	See page
AVAILABLE TO STUDENTS COMPLETING THE THIRD YEAR				
Allied Chemical Canada Limited Scholarship........	$850	No	Yes	141
American Institute of Industrial Engineers Scholarship	$150	No	Yes	141
Babb Bursary Fund..........	—	Yes	Yes	142
F. W. Baldwin Prize..........	$75	No	Yes	142
Canadian Bechtel Limited Bursaries................	—	Yes	No	143
J. P. Bickell Foundation Bursaries.................	—	Yes	Yes	144
T. H. Bickle Prize............	$30	No	Yes	144
*Boiler Inspection and Insurance Company Scholarship.......	$150	No	Yes	144
*California Standard Company Scholarship	$400	No	Yes	145
Chemical Institute of Canada Prize......................	$25	No	Yes	145
Archie B. Crealock Memorial Prize......................	$50	No	Yes	145
Dow Chemical of Canada Limited Award.............	$500	No	Yes	146
Dominion-Provincial Student-Aid Bursaries.............	—	Yes	No	146
*John M. Empey Scholarship...	$100	No	No	146
E.I.C. Prize.................	$50	No	Yes	147
Engineering Society Semi-Centennial Award..........	$75	No	No	148
J. A. Findlay Scholarship......	—	No	Yes	148
James Franceschini Foundation Scholarship...............	$250	No	Yes	148
Chester B. Hamilton Scholarship...............	$500	No	Yes	150
Hudson Bay Mining and Smelting Company Limited Scholarships...............	$800	Yes	Yes	150
*Hydro-Electric Power Commission Scholarship.........	$300	No	No	151
I.B.M.—Thomas J. Watson Memorial Bursary Fund.....	—	Yes	No	151
*Jenkins Scholarship in Engineering...............	$200	No	No	151
Johnson's Wax Scholarship....	$600	No	Yes	151

Name	Amount	Application required	Available only to a limited group or single course	See page
Kennecott Copper Award in Industrial Engineering....	$1000	Yes	Yes	152
The Lever Brothers Scholarship	$300	No	Yes	152
Loan Funds..................	—	Yes	No	167
J. A. D. McCurdy Prize.......	$75	No	Yes	153
Alexander MacLean Scholarship....................	$250	No	Yes	155
*Marsland Engineering Ltd. Scholarship................	$250	No	Yes	156
Northern Electric Undergraduate Scholarship.......	$500	No	Yes	157
Orenda Engines Scholarship ...	$500	No	Yes	158
*Professional Engineers Scholarship................	$250	No	Yes	159
Rhodes Scholarship...........	£400	Yes	No	160
RCE Memorial Scholarship....	$125	Yes	Yes	161
Frederick W. Schumacher Scholarship................	—	Yes	Yes	162
Specification Writers Association Scholarship................	$250	No	Yes	163
William Storrie Memorial Scholarship................	$100	No	Yes	164
*Spruce Falls Power and Paper Company Scholarships......	$400	No	No	163
Edith Tyrrell Memorial Bursary	$500	Yes	Yes	165
University of Toronto General Bursaries..................	—	Yes	No	166
*Wallberg Undergraduate Scholarships...............	$500	No	No	167
AVAILABLE TO STUDENTS COMPLETING THE FOURTH YEAR				
Henry G. Acres Medal........	—	No	Yes	140
American Society of Lubrication Engineers Prize..	$75	No	No	141
J. P. Bickell Foundation Bursaries..................	—	Yes	Yes	144
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	146
Electrical Manufacturing Co. Limited Prize..............	$25	No	Yes	146
Encyclopaedia Britannica Prize.	—	No	No	147
Hamilton Watch Award......	—	No	No	150

Name	Amount	Application required	Available only to a limited group or single course	See page
Ontario Chapter, A.S.H.R.A.E. Prize	$75	No	No	150
Johnson Foundation Scholarship Award	—	Yes	Yes	174
Loan Funds	—	Yes	No	167
Massey-Ferguson Ltd. Scholarships (2)	$500	Yes	Yes	156
Ontario Municipal Electric Association Bursary	$300	Yes	Yes	158
Professional Engineers Gold Medal	—	No	No	160
William Storrie Memorial Scholarship	$200	No	Yes	164
Society of Chemical Industry Merit Award	—	No	Yes	163
"Second Mile Engineer" Award	$200	No	Yes	162
Trane Company of Canada Limited Prize	$200	No	No	165
University of Toronto General Bursaries	—	Yes	No	166
W. S. Wilson Medals	—	No	No	167
AVAILABLE TO GRADUATES				
Aluminium Laboratories Limited Fellowship	—	Yes	Yes	171
Athlone Fellowships	—	Yes	No	171
J. P. Bickell Foundation Fellowships	$2000	Yes	Yes	171
C.I.L. Fellowships in Chemistry	$4000	Yes	Yes	171
Canadian Lumbermen's Association Timber Research Fellowship	$1250	Yes	No	171
Commonwealth Scholarships	—	Yes	No	172
1851 Exhibition Science Research Scholarships	£275	Yes	Yes	172
Thomas H. Hogg Overseas Fellowship	$3000	Yes	Yes	173
Imperial Oil Graduate Research Fellowships	$4000	Yes	Yes	173
International Nickel Graduate Research Fellowships	$2000	Yes	Yes	174
S. C. Johnson Foundation Scholarship Award	—	Yes	Yes	174

Name	Amount	Application required	Available only to a limited group or single course	See page
McCharles Prize	$1000	No	No	174
The University of Manchester Toronto Fund	£100	Yes	No	175
National Sewer Pipe Limited Scholarship	$500	Yes	Yes	175
Nipissing Mining Research Fellowships	$975	Yes	No	175
H. W. Price Research Fellowship in Electrical Engineering	—	Yes	Yes	175
Raymond Priestley Fellowship	£450	Yes	No	176
Rhodes Scholarship	£400	Yes	No	160
Royal Institution of Great Britain Science Research Scholarships	£350	Yes	No	176
Steel Company of Canada, Ltd., Fellowship	$1500	Yes	Yes	176
Spruce Falls Power and Paper Company Fellowships	$1200	Yes	No	177
1940 Toronto Fund	£500	Yes	No	177
Wallberg Research Fellowships	$6000	Yes	No	177
Charles G. Williams Fellowship	$1500	Yes	Yes	177
Garnet W. McKee Loan and Scholarship Fund	$800	Yes	Yes	178

NOTE—As the value of an endowed scholarship or prize is dependent on the actual income of the fund, it is possible that the value of certain scholarships and prizes at the time of payment may be less than the amount stated in the calendar.

In those cases where the amount of the award is not payable from income earned on an endowed fund, payment will be dependent on the receipt of the amount of the annual award from the donor.

HENRY G. ACRES MEDAL

The Henry G. Acres Medal is the gift of Mrs. Henry G. Acres in memory of her late husband, Henry G. Acres, M.E., D.Sc., a graduate of the School of Practical Science in the class of 1903. Throughout his professional life Dr. Acres was associated with major power developments in Canada and abroad. As chief hydraulic engineer for the Hydro-Electric Power Commission of Ontario in the period 1911 to 1923, he was responsible for the design and construction of nearly twenty power plants, including the Queenston-Chippawa development. Entering private practice in 1924, and until his death in 1945, he continued to widen and extend his interests. He became chief engineer of the Grand River Conservation Commission and responsible for the design and construction of the Shand dam and related work. Later, he was consulting engineer for the extensive power developments at Shipshaw on the Saguenay River, which was vital to the production of aluminum for war purposes. Many of the provinces of Canada sought his services and he advised with respect to work in Newfoundland, South America and India.

This medal is awarded annually to the student in the Fourth Year who is registered in the course in Civil, Mechanical, or Electrical Engineering, and who obtains the highest aggregate percentage at the annual examinations of the Third and Fourth Years, provided always that the student obtains honour standing in the examinations of the Fourth Year. Receipt of the medal does not preclude a student from being granted such other award as may in the opinion of the Council be appropriate.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by the late Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of the annual income from the fund is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance. When regulations do not permit the winner to hold this scholarship the students to be considered for the award shall be the first three in the year exclusive of any student who holds a scholarship of higher value.

ALCAN SCHOLARSHIP

The Aluminum Company of Canada, Limited has made available an admission scholarship of a value of $500.00 to a student entering the First Year of an Honours Course in the Faculty of Arts and Science, the Faculty of Applied Science and Engineering or in the Faculty of Law. The recipient must attain an academic standing satisfactory to the Com-

mittee of Award and demonstrate financial need. It is tenable on the later years provided First Class standing is maintained.

Application should be made to the Registrar of the University by May 1 on the regular Admission Scholarship Application form.

ALLIED CHEMICAL CANADA LIMITED SCHOLARSHIP

Allied Chemical Canada Limited has presented a scholarship of the value of tuition fees plus $250.00 to the student and a grant of $250.00 to the University, to be awarded to a student registered in the Fourth Year of the course in Chemical Engineering who has attained honour standing in the examinations of the Third Year. The recipient must be a Canadian or an American citizen and must not already be receiving other awards exceeding $250.00.

AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS SCHOLARSHIP

The Southern Ontario Chapter, American Institute of Industrial Engineers offers a scholarship of $150.00 to a student entering the Fourth Year of the Industrial Engineering course who has consistently maintained a high academic standing, but not necessarily honour standing, during the previous three years.

AMERICAN SOCIETY OF LUBRICATION ENGINEERS PRIZE

The Toronto Section of the American Society of Lubrication Engineers offers an annual prize of $75.00 to a student in the Fourth Year in Mechanical Engineering whose Thesis dealing with Lubrication is considered by the Head of the Department of Mechanical Engineering to be of suitable quality and the most satisfactory. The Prize is accompanied by a donation of $25.00 to the Department to purchase books on Lubrication.

AMERICAN SOCIETY FOR METALS FOUNDATION FOR EDUCATION AND RESEARCH SCHOLARSHIP

The American Society for Metals Foundation for Education and Research has donated $500.00 annually since 1953 to provide a Scholarship in the Faculty of Applied Science and Engineering.

The winner must:

(a) obtain the highest average percentage of marks at the examinations of the First Year in Metallurgical Engineering;

(b) register in the Second Year of the course.

This scholarship is not tenable with other awards in the gift of the Senate.

ONTARIO CHAPTER, AMERICAN SOCIETY FOR METALS BURSARY

The Ontario Chapter, American Society for Metals provides two bursaries of a value of $400.00 each for students entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than September 1. The first award was made for the Session 1958–59.

ARDAGH SCHOLARSHIP

The Ardagh Scholarship, of the annual value of the income from $5,500, has been provided in memory of his parents by Professor E. G. R. Ardagh, B.A.Sc., F.R.S.C., formerly professor of Applied Chemistry in the Faculty. It is awarded to the student who attains the highest standing in Honours at the annual examinations of the Second Year in the Course in Chemical Engineering. The first award was made on the results of the annual examination of 1946.

ATKINSON INCOURSE BURSARIES

Atkinson Incourse Bursaries, gift of the Atkinson Charitable Foundation, are awarded annually to students in the second or higher years of their courses. Applicants must have at least Second Class Honours in the final examinations of the preceding year, demonstrate financial need and be a resident of the Province of Ontario.

Applications must be submitted to the Registrar of the University on or before December 1st.

ATA TRUCKING INDUSTRY EDUCATIONAL FOUNDATION BURSARIES

The Automotive Transport Association of Ontario has established a bursary fund for students in the second or higher years of any undergraduate degree course who find themselves in serious financial need due to sudden, unexpected personal or family difficulties. Applications may be submitted to the University Registrar at any time during the session and the number and value of the bursaries will vary at the discretion of the Committee of Award.

THE BABB BURSARY FUND

Bursaries from this fund are available to students in any year of the Aeronautics Option in Engineering Physics. Application is made through the Secretary of the Faculty.

THE F. W. BALDWIN PRIZE

The F. W. Baldwin Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44), in memory of Frederick Walker "Casey" Baldwin, a graduate of the School of Practical Science, who made a significant contribution in the field of Aeronautics in Canada; and who flew, on March 12th, 1908, near Hammondsport, N.Y., the "Redwing," the first biplane built by the Aerial Experiment Association.

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in the annual examinations of Third Year in "structural subjects."

The first award was made on the results of the examinations of the Session 1953–54.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that a scholarship of one half the annual income

shall be awarded annually to an engineering student on the record of the First Year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship, up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the annual examinations of the First Year, enrolled in any one of the courses of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, or Metallurgical Engineering, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those courses. The first award was made on the results of the annual examinations of the Session 1925–26.

CANADIAN BECHTEL LIMITED BURSARIES

Canadian Bechtel Limited has established Bursaries in the Faculty of Applied Science and Engineering of an annual value of $1,200.00 to provide not more than four awards, each of a minimum value of $200 and a maximum value of $600. Two awards will be made to First Year students and one or two awards to students registered in any year of the Faculty. Applicants must demonstrate financial need and have academic standing satisfactory to the Faculty Council.

Application must be made to the Secretary of the Faculty on or before October 1st.

J. P. BICKELL FOUNDATION SCHOLARSHIPS

The Trustees of the J. P. Bickell Foundation have established scholarships, the number to be determined annually, in the Faculty of Applied Science and Engineering of a possible value of Fifteen Hundred Dollars, payable $500 in the First Year and provided honours are obtained at the Annual Examinations, $500 in the Second and Third Years.

An applicant must obtain an average of at least 75% at the Ontario Grade XIII examinations immediately preceding his admission to the university and must undertake to enrol in Mining Engineering, Metallurgical Engineering or Applied Geology. Failing suitable candidates in the courses mentioned students registered in the Second Year Honour course in Geological Sciences, or Physics and Geology in the Faculty of Arts and Science who are academically qualified are eligible. These awards are of the same value and are tenable in the Second, Third and Fourth Years of the course, subject to maintenance of the required academic standing. If any scholarships are not awarded to those mentioned above, students registered in the Third Year of the Engineering Science course in the Faculty of Applied Science and Engineering and taking the Physical Metallurgy or the Geophysics option who are academically qualified are eligible. In this case the scholarship will have a value of $1,000, payable $500 in each of the Third and Fourth years, provided the required academic standing is maintained.

Applications from those entering First Year must be submitted to the Registrar of the University not later than May 1st on the regular admission scholarship application form.

J. P. BICKELL FOUNDATION BURSARIES

The Trustees of the J. P. Bickell Foundation have established the J. P. Bickell Foundation Bursaries in the Faculty of Arts and the Faculty of Applied Science and Engineering. An applicant must be enrolled in Honour Science or in Mathematics, Physics and Chemistry in the Faculty of Arts, in which case he must undertake to study mining or geology in his higher years; or be enrolled in a higher year of an honour course in the geological or geophysical field in the Faculty of Arts; or be enrolled in Mining Engineering, Metallurgical Engineering, and Applied Geology in any year of the Faculty of Applied Science and Engineering. He must demonstrate financial need and have satisfactory academic standing.

Application must be made to the Registrar of the University on or before December 1st.

THE T. H. BICKLE PRIZE

The T. H. Bickle Prize is the gift of Mr. and Mrs. E. W. Bickle in memory of their son, T. H. Bickle, an undergraduate of Trinity College and a member of the Senior Intercollegiate Swimming Team at the time of his death in 1937. The income from the endowment fund will be used to purchase a suitable prize to be awarded annually to a member of the Senior Intercollegiate Swimming Team of this University in any year, faculty or school. The Committee of Award shall consist of the Dean of the Faculty of Arts, the University Registrar, the Director of Athletics, and the Honorary Coach of Swimming. In awarding the Prize the Committee shall consider the character, scholarship, and general interests of the members of the team.

J. W. BILLES ADMISSION SCHOLARSHIPS

Admission scholarships have been established from a bequest from the estate of J. W. Billes, open to students entering any degree course in the University. The value in each year is a minimum of $200.00 and a maximum of $1,500.00 dependent upon the financial need of the recipient. Applicants must satisfy the normal admission scholarship standards in their Grade XIII examinations to be eligible for an award and maintain first class honour standing to enjoy the scholarship in higher years. The number of scholarships awarded in any one year may be varied dependent upon the available funds.

Application should be made to the Registrar of the University by May 1 on the regular admission scholarship application form.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a scholarship in the Course in Mechanical Engineering of the value of One Hundred and Fifty Dollars to the student who obtains highest honour standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Chief Accountant to the fees of the Fourth Year of the successful candidate.

CALIFORNIA STANDARD COMPANY SCHOLARSHIP

The California Standard Company has presented a scholarship of $400.00 to a student who achieves outstanding results in the annual examinations of the Third Year in the Geophysics Option in Engineering Physics or in Applied Geology in the Faculty of Applied Science and Engineering or achieves the highest standing at the annual examinations of the Third Year in Physics and Geology or Geological Sciences in the Faculty of Arts and Science.

The awards alternate annually between the Faculties of Applied Science and Engineering and Arts and Science and the First award was made in the session 1960–61 in the Faculty of Applied Science and Engineering.

CARVETH METALLURGICAL LTD. BURSARY

Carveth Metallurgical Ltd. provides a Bursary of $500.00 for a student entering the Third Year of Metallurgical Engineering. The award is made primarily on the basis of Second Year standing, but the need for financial assistance will also be taken into consideration.

The Bursary is available every third year, beginning in the Session 1961–62, and is to be awarded on the recommendation of the Department of Metallurgical Engineering. Applications should be made by letter to the Secretary of the Faculty of Applied Science not later than September 1st of the year in which the award is tenable.

CHEMICAL INSTITUTE OF CANADA PRIZE

The Chemical Institute of Canada offers a prize of the annual value of $25.00 in books to the student registered in the course in Chemical Engineering who, having obtained honours, receives the highest standing in the written and laboratory work of the Third Year.

The first award was made on the results of the final examinations of 1947.

ARCHIE B. CREALOCK MEMORIAL PRIZE

The Archie B. Crealock Memorial Prize is the gift of Mrs. Archie B. Crealock, in memory of her husband, an eminent bridge engineer and a graduate of the Faculty of Applied Science and Engineering of the University of Toronto. It is offered annually to the student of the Third Year in the Course in Civil Engineering, who, having obtained honours in that year, is deemed to be the most worthy of the award. The award is made primarily on the basis of academic standing in the structural subjects of the Year, but extra-curricular activities are also taken into consideration. The Prize consists of engineering books to the value of Fifty Dollars. The award will not necessarily be made in any year.

DOMINION MAGNESIUM LIMITED BURSARY

Dominion Magnesium Limited provides a bursary of $400.00 for a student entering the First Year in Metallurgical Engineering. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than 1st September. The first award was made in the Session 1958–59.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "A"

These Bursaries are available to students in financial need who are resident in Ontario, are entering the First Year of University, and have attained an average of at least 66% on eight Grade XIII papers. Application is made not later than June 15th, through the Principal of the secondary school which the student is attending.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "B"

Under this programme, Bursaries may be awarded to students in financial need who are resident in Ontario and who are in attendance at the University of Toronto. To be eligible, students must have obtained not less than sixty-six per cent. at their last annual examination. Further information may be obtained from the Secretary of the Faculty, to whom application must be made by the first week in October.

DOW CHEMICAL OF CANADA LIMITED AWARD

Dow Chemical of Canada Limited have provided funds for an annual award of $500.00 to a student in Chemical Engineering in the Faculty of Applied Science and Engineering, and a grant-in-aid of $250.00 to be used in the winner's department to help defray the cost of equipment, supplies and administration.

The winner must:

(a) be registered in the Third Year in Chemical Engineering (the award will be made in the second term of the Third Year and will be paid to the winner during his Fourth Year)
(b) be in the upper half of the class
(c) have demonstrated leadership in extra-curricular activities.

The award is not tenable with other awards in the gift of the Senate. Application is not required.

THE ELECTRICAL MANUFACTURING COMPANY LIMITED PRIZE

The Electrical Manufacturing Company Limited has established an annual Prize of $25.00 in the Faculty of Applied Science and Engineering.

The winner must:

(a) be registered in the Fourth Year in Electrical Engineering
(b) obtain the highest aggregate percentage of marks at the final examinations in the subjects of the Fourth Year related to electrical distribution equipment, the subject to be determined by the Head of the Department of Electrical Engineering.

This prize is tenable with other awards in the gift of the Senate.

THE JOHN M. EMPEY SCHOLARSHIPS

The John M. Empey Scholarship Fund was established under a bequest of $10,000 in the Will of the late John Morgan Empey, B.A.Sc., 1903. Three scholarships of equal value are provided from the income

from the Fund. One of these scholarships is awarded in each of the First, Second, and Third Years on the results of the annual examinations, to a student who, taking honours, obtains the highest average percentage of marks in the written and laboratory subjects of his Year. The scholarships are open to any students registered in the Faculty. In case the winner of any one of these scholarships does not attend this Faculty during the session next following the award, the right to the scholarship shall be forfeited and the award shall be made to another eligible student. The scholarships were awarded for the first time in 1944.

THE ENCYCLOPAEDIA BRITANNICA PRIZE

Encyclopaedia Britannica of Canada Limited presents a prize consisting of a set of books "Great Books of the Western World" to a student of the Fourth Year in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and has achieved high aggregate marks during his four years in the social-humanistic subjects common to all years.

ENGINEERING ALUMNI ADMISSION BURSARIES

The Engineering Alumni Association has made a number of bursaries with a maximum value of $600 each available annually. Applicants must be residents of Ontario, register in the First Year of the Faculty of Applied Science and Engineering, and need financial assistance.

Applicants should consult their secondary school Principal for details. Further information may be obtained from the Chairman, Engineering Alumni Education Committee, Faculty of Applied Science and Engineering, University of Toronto.

ENGINEERING ALUMNI ADMISSION SCHOLARSHIP

The Engineering Alumni Admission Scholarship, the gift of the Engineering Alumni Association, of the value of $500, is awarded to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional

knowledge among its members, offers an annual prize of Fifty Dollars in this University, commencing 1931, to the student who, in his Third Year in any one of the six courses of Engineering, has proved himself most deserving as disclosed by the examination results of the year, in combination with his activities in the Engineering Society or with a local branch of another recognized engineering organization.

ENGINEERING SOCIETY SEMI-CENTENNIAL AWARD

The Engineering Society Semi-Centennial Award, to the value of Seventy-five Dollars, was established in 1931 to commemorate the semi-centennial of the founding of the "School". The award is made to a student entering the final year.

The selection is based upon the following qualifications, which bear equal weight in the selection of the winner: (*a*) General "School" activities. (*b*) Contributions to the Engineering Society Executive Committee. (*c*) Personality, and social and athletic activities. (*d*) Academic standing.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available, each of a value of one half of the income of the fund, to students in this Course, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the student's general character, fitness for his profession, and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award shall be made to another eligible student.

THE JAMES FRANCESCHINI FOUNDATION SCHOLARSHIP

This scholarship, of a value of $250, is awarded to the student in Civil Engineering who achieves the highest standing, with honours, at the annual examinations of the Third Year among those who do not hold an award of a value of $100 or more based on the results of these examinations.

HUGH GALL AWARD

The Hugh Gall Award, of the annual value of One Hundred and Forty Dollars, the gift of the Graduate Class of 1910, "to commemorate a deceased classmate who was a splendid type of student, a loyal friend, and nationally outstanding in athletic achievement during his undergraduate career", was established in 1946 for a five year period and, through the generosity of Mrs. Hugh Gall extended for a further three year period. It is awarded to a student, who, having completed his First Year with a

general average of at least 66% without conditions, has entered the Second Year, and is in special need of financial assistance in order to enable him to continue his course. It is desirable, but not necessary, that the recipient shall not already have been given any other scholastic award or scholarship applicable to the Second Year and he shall have shown indications of his firm intention and ability to follow successfully the profession of engineering.

Any second year student in the Faculty of Applied Science and Engineering is eligible to apply for this Bursary. Applications should be made to the Secretary of the Faculty not later than one month after the opening of the session.

THE GRABILL ADMISSION SCHOLARSHIP

The Grabill Admission Scholarship is the gift of Mr. Dayton L. Grabill, a graduate of this Faculty in 1924. The Scholarship has a value of approximately $400.00. It is awarded to the candidate who has standing amongst those with the highest average percentages in the subjects of Ontario Grade XIII required for admission to the Faculty of Applied Science and Engineering. Applicants are required to write the Problems paper but standing in this paper is used only as auxiliary information. The candidate must write the Grade XIII examinations at one sitting in the June preceding entry to the University after not more than one year's instruction in Grade XIII and must register in the Faculty of Applied Science and Engineering.

Application should be made to the Registrar of the University on the regular Admission Scholarship form by May 1.

THE REGINALD AND GALER HAGARTY SCHOLARSHIP

The Reginald and Galer Hagarty Scholarship, in memory of the dearly beloved sons of Lieutenant-Colonel E. W. Hagarty, B.A. 1883, M.A. 1908, and Charlotte Ellen Hagarty, his wife. Reginald Edward Walter Hagarty, B.A.Sc. (Honours) 1908, a graduate of the University in the Faculty of Applied Science and Engineering and at the time of his death on April 29, 1925, a Consulting Structural Engineer. Lieutenant Daniel Galer Hagarty, Princess Patricia's Canadian Light Infantry, a member of the class of 1916 in Applied Science, enlisted for the Great War at the end of his third year in June, 1915, killed in action in Sanctuary Wood, June 2, 1916. The scholarship is given in recognition of the fact that their father was an honour graduate in Classics of the University of Toronto. It is of the value of the annual interest on the capital sum of $2000.00 and is to be awarded to a student who has been enrolled for his Grade XIII Year at Harbord Collegiate Institute and having obtained at least the required standing in each of the Grade XIII subjects necessary for admission to the Faculty, obtains the highest standing in English, a language other than English, and Mathematics, among the students who apply for the award from the Collegiate. He will be required to: (*a*) register in the Faculty of Applied Science and Engineering, (*b*) sign a declaration to the effect that he is willing to take up arms in the defence of Canada and the British Commonwealth should necessity arise as declared by the Parliament of Canada. The Scholarship was offered for award for the first time in 1945. Application should be made to the Registrar of the University.

CHESTER B. HAMILTON SCHOLARSHIP

Members of the family of the late Chester B. Hamilton, a graduate of this Faculty in 1906, have presented a Scholarship in his memory of the annual value of $500.00. It is held by a Fourth Year student in Mechanical Engineering who has achieved outstanding academic standing at the Annual Examinations of the Third Year.

The first award was made on the results of the examinations for the Session 1958–59.

HAMILTON WATCH AWARD

Hamilton Watch Company, Lancaster, Pa. presents a wrist watch, suitably engraved, to the Fourth Year student in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and who has achieved high aggregate marks during his four years in the social-humanistic subjects common to all courses.

ONTARIO CHAPTER, A.S.H.R.A.E. PRIZE

The Ontario Chapter of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers offers an annual prize of Seventy-five Dollars, first awarded in 1931, for a period of five years, and extended indefinitely in 1935. The prize will be awarded to a student in either the Third or Fourth Year in any Course of the Faculty who, in the opinion of the Department of Mechanical Engineering, has written the most satisfactory thesis on a subject dealing with heating, ventilating, air-conditioning or refrigeration, such thesis being prepared under special arrangements made by the Department of Mechanical Engineering, the result to be reported to the Council with the annual examination results. The thesis must be handed in not later than March 1. The prize will not necessarily be awarded in any year.

Application should be made to the Department of Mechanical Engineering.

THE MURRAY CALDER HENDRY SCHOLARSHIP

This award was established by the estate of Mrs. Grace Appel Hendry as a memorial to her husband, a graduate of this Faculty in 1905. It has a value of the income from a capital sum of $10,000 and the recipient must:

(a) have attained an average of at least 75% on nine grade XIII examination papers, written at one sitting, required for admission to the Faculty and have the highest marks in the Problems paper;

(b) be entering the First Year of any course in the Faculty of Applied Science and Engineering.

Application must be made to the Registrar of the University by May 1 on the regular University Admission Scholarship Application form.

The first award will be made for the session 1962–63.

HUDSON BAY MINING AND SMELTING COMPANY LIMITED SCHOLARSHIPS

The Hudson Bay Mining and Smelting Company Limited awards Scholarships to students who have obtained their Senior Matriculation at the High Schools in Flin Flon, Manitoba, and its environs. These

Scholarships, having a value of $800.00 each annually, may be held in the Third and Fourth Years in this Faculty, in the Course in Chemical Engineering, Metallurgical Engineering, Mining Engineering, and Applied Geology. Application should be made to the Company.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO SCHOLARSHIPS IN ENGINEERING

The Hydro-Electric Power Commission of Ontario has presented three scholarships in Engineering, each of a value of $300.00 to be awarded to three students selected from among the higher ranking students in the annual examinations of the First, Second, and Third Years in any course in the Faculty, one scholarship in each year to be tenable in the Second, Third and Fourth Years respectively.

The first award was made at the annual examinations in April, 1952.

IBM—THOMAS J. WATSON MEMORIAL BURSARY FUND

International Business Machines Company Limited has made available one or more bursaries of a total annual value of $1,000.00 to students registered in any year of a full time course in the university who have standing satisfactory to the Committee of Award and demonstrate financial need.

Application should be made to the Registrar of the University by October 31.

THE INCO SCHOLARSHIP

The International Nickel Co. of Canada Limited has established a Scholarship for students entering the University. Each Scholarship provides for tuition fees plus $300.00 and may be continued throughout a four-year course if satisfactory standing is maintained.

To be eligible for consideration the applicant must obtain an average of 75% or over in the Ontario Grade XIII subjects required for admission to his course and demonstrate financial need.

Application must be made to the Registrar of the University by May 1st on the regular scholarship application form.

JENKINS SCHOLARSHIP

The Jenkins Scholarship, presented by Jenkins Bros., Limited, Montreal, first awarded in 1925, has been donated to continue indefinitely.

This Annual Scholarship, of the value of Two Hundred Dollars, is awarded to the student of the Third Year registered in any course of the Faculty who has the highest aggregate of percentages for the First, Second, and Third Years.

JOHNSON'S WAX SCHOLARSHIP

S. C. Johnson and Son Limited, Brantford, Ontario, have established a Scholarship of an annual value of $600 in each of the Second, Third and Fourth Years or a total possible value of $1800.

The recipient must:

(*a*) be registered in Chemical Engineering in the years in which the Scholarship is awarded and held;

(*b*) in the opinion of the Council be the most promising and deserving member of the class, obtaining Honours in the final examinations of the First Year;
(*c*) in his Second and Third Years, maintain academic standing satisfactory to the Council, not necessarily Honours, for the continued enjoyment of the Scholarship.

In its discretion the Council may recommend the award of any portion of the Scholarship, lost by the original recipient by failure to maintain satisfactory academic standing, to another student of the year(s) in which the Scholarship would otherwise have been enjoyed.

The first award was made on the results of the annual examinations written in April 1954. It is not tenable with any other Scholarship.

KENNECOTT COPPER AWARD IN INDUSTRIAL ENGINEERING

Kennecott Copper Corporation offers an Annual Award in Industrial Engineering of the value of $1,000.00. The recipient of the Award must:
(a) be registered in the Second, Third or Fourth year of the course in Industrial Engineering;
(b) have attained Honours in the final examinations of the previous year;
(c) show qualities of leadership and initiative.

The financial need of the student may be taken into consideration.

Application should be made to the Secretary of the Faculty by October 30.

KIMBERLY-CLARK CORPORATION OF CANADA LIMITED SCHOLARSHIPS

Kimberly-Clark Corporation of Canada Limited has presented two scholarships of a value of $500.00 each and each scholarship is accompanied by a grant of $100.00 to the general funds of the University. The Scholarships are awarded on the annual examinations of the First and Second Years and one scholarship is awarded to an outstanding student of the First Year and one to an outstanding student of the Second Year as indicated by the examination results of their respective years. Students in all courses of the First and Second Years are eligible.

The First awards were made on the results of the annual examinations for 1957–58.

THE LEVER BROTHERS SCHOLARSHIPS

Lever Brothers Limited have established two Scholarships of $300.00 each in the Department of Chemical Engineering. The Scholarships will be awarded to a student of the Second Year and to a student of the Third Year in Chemical Engineering to be held in the Third and Fourth Years respectively. The award is based on outstanding scholarship at the annual examinations.

The first awards were based on the annual examinations of 1957.

THE LEONARD FOUNDATION SCHOLARSHIPS

Leonard Foundation Scholarships are awarded each year to selected students in Universities and Colleges across Canada, including the University of Toronto. The Trust Deed states: "Preference in the selection of students for scholarships shall be given to the sons and daughters re-

spectively of the following: (*a*) clergymen, (*b*) school teachers, (*c*) officers, non-commissioned officers and men, whether active or retired, who have served in His Majesty's military, naval or air forces, (*d*) graduates of the Royal Military College of Canada, (*e*) members of the Engineering Institute of Canada, (*f*) members of the Mining and Metallurgical Institute of Canada."

All applicants must be nominated by a member of the General Committee. The latest date for the receiving of applications is March 31st, for the following academic year. Further information regarding the procedure to be followed in applying for these scholarships may be obtained by writing to Dr. W. E. Taylor, Honorary Secretary, The Leonard Foundation, c/o Toronto General Trusts Corporation, 253 Bay Street, Toronto.

THE J. EDGAR MCALLISTER FOUNDATION

Through the generosity of the late J. Edgar McAllister, a graduate of the Faculty in 1891, a fund has been established in the university to be known as the J. Edgar McAllister Foundation, to provide financial aid for students who require it, in Mining, Mechanical, Chemical, Electrical and Metallurgical Engineering. Inquiries should be made in the Faculty Office.

THE JOHN WOLFE MCCOLL MEMORIAL AWARDS

These six awards, two of which are open to students in the Faculty of Applied Science and Engineering, are the gift of the estate of the late John Wolfe McColl. The awards have a minimum value of $250.00 and a maximum of $750.00. Applicants must have obtained First Class Honours at the final examinations of the preceding year, whether Ontario Grade XIII or at the University of Toronto, demonstrate financial need and be enrolled or undertake to enrol in either Engineering Physics or Chemical Engineering. Students seeking first admission to the University must submit applications for an award to the Registrar of the University on or before May 1st. Students in the University must submit applications for an award to the Registrar of the University on or before October 15th.

THE J. A. D. MCCURDY PRIZE

The J. A. D. McCurdy Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44) in honour of John Alexander Douglas McCurdy, a graduate of the School of Practical Science, who "made the first flight in Canada on February 23rd, 1909, with a heavier-than-air machine."

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Physics, who, taking honours, ranks highest in annual examinations of the Third Year in the subjects related to Aerodynamics.

The first award was made on the results of the examinations of the Session 1953–54.

THE GARNET W. MCKEE-LACHLAN GILCHRIST SCHOLARSHIP IN ENGINEERING PHYSICS

Mrs. Garnet W. McKee and Professor Lachlan Gilchrist each contributed $1000.00 to provide for a Scholarship in the First Year of the Course in Engineering Physics. The value of the Scholarship is the annual income from the capital fund and is awarded to the student who ranks first in honours at the annual examinations of the First Year in the Course in Engineering Physics. If for any reason that student is ineligible to hold the Scholarship, it will be awarded by reversion to the student ranking second in honours in the Course. In order to receive payment the winner must register in the Second Year of the Course in Engineering Physics. The Scholarship was awarded for the first time on the results of the annual examinations of 1947.

THE GARNET W. MCKEE-LACHLAN GILCHRIST GEOPHYSICS SCHOLARSHIPS

Financial assistance was received by Professor Lachlan Gilchrist of the Department of Physics, University of Toronto, from certain organizations and individuals to help him in the prosecution of his research work in Geophysics. With the consent of the contributors, the unexpended balance of these gifts was transferred by Professor Gilchrist to the Board of Governors of the University to be used as an endowment for scholarships, two of which were established in the Faculty of Applied Science and Engineering. To this fund have been added additional amounts received from the estate of the late Garnet W. McKee and from the Hollinger Consolidated Gold Mines Ltd. They are awarded by the Senate, on the recommendation of the Council of the Faculty of Applied Science and Engineering. The first awards were made on the results of the Annual Examinations of 1941.

The First Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $4,000.00, is awarded to the student in the Second Year in the Course of Engineering Physics who obtains the highest aggregate standing at the examinations of the First and Second Years in the Course, provided always that the student obtains honour standing at the examinations of the Second Year.

The Second Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $3,000.00 is awarded to the student in the Second Year in the Course of Engineering Physics who, of those students who elect to proceed in the Third Year in the Geophysics Option of the Course, obtains the highest aggregate standing at the examinations of the First and Second Years, provided always that the student obtains honour standing at the examinations of the Second Year, and excluding always the student to whom the First Lachlan Gilchrist Geophysics Scholarship has been awarded.

If in any year there is no student who has fulfilled the conditions as laid down for the Second Lachlan Gilchrist Geophysics Scholarship, it shall be awarded to the student in the Second Year in the Course in Engineering Physics who obtains the second highest aggregate standing

at the examinations of the First and Second Years of that Course, provided always that such student obtains honour standing in the examinations of the Second Year.

THE ALEXANDER MACLEAN SCHOLARSHIP

This scholarship was established by graduates of the University of Toronto and other friends in honour of Professor Alexander MacLean, B.A. (1908) who retired in 1954. The scholarship, of the value of $250, is awarded to a student in the Third Year of Geological Sciences, Faculty of Arts, or in the Third Year of Applied Geology, Faculty of Applied Science and Engineering, who, obtaining not less than 75% in the work of the year, obtains the highest standing in the geological subjects common to the two courses.

The first award was made in 1955.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize is awarded to the First Year student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. If in any year no award is made, a second award will be available in a subsequent year.

CHARLES GORDON MANNING PRIZE

The Charles Gordon Manning Prize was established by a bequest under the Will of the late Jennie Manning in the amount of Five Hundred Dollars ($500), the annual income from which is to be used to buy books for the winner of the Prize.

The recipient must be enrolled in the Second Year of a course offered by the Faculty of Applied Science and Engineering and, in the opinion of the Council, rank second to the student awarded the Harvey Aggett Memorial Scholarship in the considerations specified for the award of that Scholarship, namely, obtaining honours in his final examinations and being one of the first three in his year by his standing at those examinations relative to the pass requirements in his Department and being "adjudged highest of the three in general student activities and service in the University during his period of attendance."

The first award was made on the results of the Annual Examinations of 1954.

MARSLAND ENGINEERING LIMITED SCHOLARSHIP

The Marsland Engineering Limited Scholarship, the gift of Marsland Engineering Limited, has a value of Two Hundred and Fifty Dollars. It is awarded to the student who, having been granted a Dominion-Provincial Student Aid Bursary in his First Year, is registered in Mechanical or Electrical Engineering and obtains the highest average percentage of marks, with honours, at the annual examination of the First, Second or Third Years in the session in which the award is made.

The first award was made at the annual examinations of 1954.

MASSEY-FERGUSON LIMITED SCHOLARSHIPS

Massey-Ferguson Limited has established two scholarships each of an annual value of $250.00, to be awarded on the recommendation of the Council of the Faculty of Applied Science and Engineering to students registered in the Fourth Year of the Courses in Mechanical Engineering or Industrial Engineering. In making the award academic achievement, financial need, extra-curricular activities and such other factors as may be deemed appropriate will be taken into consideration.

Application should be made to the Secretary of the Faculty not later than 15th October.

THE W. G. MILLAR MEMORIAL SCHOLARSHIP

The W. G. Millar Memorial Scholarship is presented by Marsh and McLennan, Limited, of an annual value of $250.00, in memory of the late Mr. W. G. Millar, a member of the Class of 1914 in Civil Engineering. The Scholarship will be awarded to a student entering the Third Year in Mining Engineering, on the recommendation of the Head of the Department of Mining Engineering.

The award will be made on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

MOBIL OIL OF CANADA LIMITED SCHOLARSHIP

Mobil Oil of Canada Limited has donated a scholarship of the annual value of $400.00, tenable in the Third Year of either the Honours Course in Geological Sciences (Faculty of Arts and Science) or the course in Applied Geology (Faculty of Applied Science and Engineering). Failing a suitable candidate in either of these courses, an award may be made to a student enrolled in the Third Year of either the Honours Course in Physics and Geology (Faculty of Arts and Science) or in the Geophysics

Option of the course in Engineering Science (Faculty of Applied Science and Engineering).

The award is based on academic performance in the first two years of the course. Other factors, including good character, personality, breadth of interest, initiative, willingness to assume responsibility and ability to co-operate with associates, may be taken into consideration. Applications are not required.

JAMES L. MORRIS MEMORIAL PRIZE

The James L. Morris Memorial Prize is the gift of Mrs. J. H. Craig and Mr. J. R. Morris, K.C., in memory of their father, James L. Morris, C.E., O.L.S., D.Eng., the first graduate of the School of Practical Science, who died in 1946 after a distinguished career. Graduating in Civil Engineering in 1881 as the sole member of his class, Dr. Morris engaged in railway work for some time, first as an engineer and then as a contractor. For 43 years he conducted a successful civil engineering practice in Pembroke, Ontario, involving important undertakings in the field of municipal, power and bridge work.

This Prize, of the value of the annual income from $3,000.00, is awarded annually to the student in the Second Year in the Course in Civil Engineering who obtains the highest aggregate percentage at the annual examinations of the First and Second Years of the course, provided always that the student obtains honour standing at the Examinations of the Second Year.

NORTHERN ELECTRIC UNDERGRADUATE SCHOLARSHIP

The Northern Electric Company Limited have established a Scholarship in the Faculty of Applied Science and Engineering and the Faculty of Arts of an annual value of $500.00. In this Faculty the scholar must be registered in the Second or Third Year of Electrical Engineering, Mechanical Engineering, Engineering Physics or Engineering and Business. He must also (a) be a Canadian citizen or landed immigrant and (b) have a minimum of 75% or its equivalent in the previous annual examinations, in this or another recognized University. This scholarship is not tenable with other awards from commercial sources, or with awards stipulating subsequent employment as a condition (e.g. R.O.T.P.)

The award is made alternately in the two faculties, the first in the Faculty of Arts in 1959 and in the Faculty of Applied Science and Engineering in 1960 and in a similar manner thereafter. Application is not required.

THE ONTARIO HOCKEY ASSOCIATION WAR MEMORIAL SCHOLARSHIP

The Ontario Hockey Association War Memorial Scholarship, the gift of the Ontario Hockey Association, is to be awarded annually at the Grade XIII examination to a man student who has served overseas with the Canadian forces, or to a student who is the son or daughter of one who has so served.

The value of this scholarship is $100 in cash, with an allowance of the same amount on the tuition fee for each session.

In determining the award of the scholarship, the academic qualifications of the candidate shall be first taken into account, provided always that no candidate shall be eligible for an award who has not met all the conditions required by the University of candidates for admission scholarships generally; but, *cæteris paribus*, the award shall be made to a student who is in proved need of assistance.

The award shall be made by the Senate of the University upon the report of a committee to be appointed by the Senate, upon which committee there shall be always one member of the Staff of the University who shall be deemed to be the representative of the Association.

Candidate shall make application not later than May 1st on the special form to be obtained from the Registrar of the University.

ONTARIO MUNICIPAL ELECTRIC ASSOCIATION BURSARY

District No. 4 of the Ontario Municipal Electric Association has provided a Bursary of $300.00 in the Faculty of Applied Science and Engineering.

An applicant for the Bursary must:

(a) be registered in the Fourth Year, Electrical Engineering
(b) have good academic standing
(c) be in need of financial assistance

Application should be made to the Secretary of the Faculty not later than October 15th.

ORENDA ENGINES SCHOLARSHIPS

Orenda Engines Limited have donated three scholarships each of a value of Five Hundred Dollars, awarded annually to students completing the First, Second and Third Years respectively in courses other than Mining Engineering and Applied Geology. These scholarships are awarded to students with high academic standing and in cases of close competition, preference will be given to the student who indicates that he possesses initiative and leadership qualities and that he will be a credit to his profession after graduation.

This award may be held with other awards provided that the monetary value of the other awards does not exceed One Hundred Dollars. The first award was made in the Session 1955–56.

PAULIN MEMORIAL SCHOLARSHIP

The Paulin Memorial Scholarship, provided through the generosity of the late Mr. Fred W. Paulin, a graduate of the Faculty in 1907, was established in memory of his brother, John Cameron Paulin, a student in Mining Engineering, who was fatally injured in 1906 during a football practice. The Scholarship which has a value of annual income from capital fund of $10,000.00, approx. $400.00, is awarded on the recommendation of the Department of Mining Engineering to a student registered in Mining Engineering, who has successfully completed the work of the First Year.

The award is made on the following bases:

(*a*) academic proficiency.

(*b*) qualities necessary for the development of leadership, such as ambition, initiative, resourcefulness and strength of character.

(*c*) he must continue his studies in Mining Engineering during the following session.

The first award was made for the Session 1951–52.

PROCTER AND GAMBLE BURSARY PLAN

Procter and Gamble Bursaries, the gift of the Procter and Gamble Company of Canada, are awarded annually to students in all years. Applicants must have at least Second Class Honours or better in the final examinations of the preceding year and demonstrate financial need. Applications must be submitted to the Registrar of the University on or before December 1st.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO ADMISSION SCHOLARSHIP

The Association of Professional Engineers of the Province of Ontario has established an Admission Scholarship in Engineering of the value of $500.00. It is awarded to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its euivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Application must be made to the Registrar before May 1.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO SCHOLARSHIPS

The Association of Professional Engineers of the Province of Ontario offers Scholarships of a value of $250.00 in each of the First, Second and Third Years in the Faculty of Applied Science and Engineering in any course, to the students who, taking Honours, obtain the highest standing in the work of their respective years.

These scholarships will not be awarded to students who hold other scholarships.

PROFESSIONAL ENGINEERS GOLD MEDAL

The Association of Professional Engineers of the Province of Ontario has established in the Faculty of Applied Science and Engineering an award in the form of a gold medal accompanied by a gift of technical books of an approximate value of fifty dollars. The award will be made to the student of the final undergraduate year in any course who, taking honours, obtains the highest weighted average percentage in the practical work and written examinations of the year.

RANSOM SCHOLARSHIP IN CHEMICAL ENGINEERING

The Ransom Scholarship in Chemical Engineering is presented by A. C. Ransom, Esq., of Toronto, for the purpose of encouraging and giving financial assistance to students who choose the field of Chemical Engineering. This donation, consisting of $5,000, provides for a perpetual scholarship of an annual amount such as will be derived from the income of this sum. The first award was made on the results of the annual examinations of 1938.

The scholarship will be awarded annually to the student registered in the Course in Chemical Engineering who obtains the highest aggregate percentage of marks in the examinations of the First Year. The scholarship will be paid to the winner only if he proceeds to take his Second Year in the Course in Chemical Engineering in the University of Toronto.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer for award in the Province of Ontario two out of ten of the Rhodes Scholarships for Canadians, each of the basic value of £400 a year but temporarily increased to £750. They are tenable ordinarily for two years at the University of Oxford. A third year given conditionally at Oxford or elsewhere abroad may be authorized in proper cases.

Each candidate must be a British subject with at least five years domicile in Canada and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year *for* which he is elected; he must have completed the first year and have entered upon the second year of his course at a Canadian university at the time of application.

A candidate may apply either for the province in which he has his private home or residence, or for the province in which he has taken his university course.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;

(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;

(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;

(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Some definite quality of distinction, whether in intellect, character or personality, or in any combination of these, is the most important requirement. Financial need does not receive special consideration.

Forms of application and full information regarding these scholarships may be obtained from D. R. Michener, Esq., Q.C., 5 Rosedale Road, Toronto 5, General Secretary for the Rhodes Scholarships in Canada or from A. B. Harvey, Esq., Q.C., c/o Law Society of Upper Canada, Osgoode Hall, secretary of the Ontario Selection Committee, or from the University Registrar. Selection is made in December each year for the scholarships for the year following. Application must be made to Mr. Harvey or the appropriate provincial secretary on or before November 1st.

R.C.E. MEMORIAL SCHOLARSHIP

The Memorial Fund Committee of the Royal Canadian Engineers has established the R.C.E. Memorial Scholarship of a value of One Hundred and Twenty-five Dollars, open to students who have successfully completed their second to last year in the Faculty of Applied Science and Engineering or the School of Architecture.

A candidate must be

(a) a member in good standing of the Canadian Officers Training Corps and have successfully completed one summer season's training

or

(b) an ex-member of the Canadian Officers Training Corps who has successfully completed his three years of C.O.T.C. training

or

(c) a member of the Canadian Army (Regular) attending University under the Regular Officers Training Plan.

Selection is made on the basis of academic standing and of qualities of leadership.

Application forms may be obtained at the C.O.T.C. Orderly Room, 119 St. George St.

HELEN E. ROGERS ADMISSION SCHOLARSHIPS

Admission scholarships have been established from a bequest from the estate of Helen E. Rogers open to students entering any degree course in the University. Preference is given to applicants from outside Ontario but failing such candidates awards may be made to qualified Ontario students. Recipients must have a standing satisfactory to the Committee of Award on first admission and may continue to enjoy the scholarship in the upper years provided they maintain first class standing. The value in each year is a minimum of $200.00 and a maximum of $1,500.00 dependent on financial need. The number of awards made each year is determined by the annual income available.

Application should be made to the Registrar of the University by May 1 on the regular admission scholarship application form.

FREDERICK W. SCHUMACHER SCHOLARSHIP

The Frederick W. Schumacher Scholarship has been established in the Faculty of Applied Science and Engineering and in the Faculty of Arts under a bequest of the late Frederick W. Schumacher. It has a value of the income from the fund. The scholar must (a) be enrolled in the Second, Third or Fourth years in Mining Engineering or Applied Geology in the Faculty of Applied Science and Engineering or in Physics and Geology or Geological Sciences in the Faculty of Arts and (b) must have high academic standing.

Applications must be submitted to the University Registrar not later than October 15th.

THE SCOTTISH RITE MASONS' BURSARY

The Scottish Rite Masons' Bursary, the gift of the Scottish Rite Masons of Toronto, of the value of $400.00 is awarded to a student enrolled in the Second Year who is a member of the Masonic Order, or a son, brother, nephew, daughter, sister or niece of a member of the Masonic Order. Consideration will be given to financial need and academic standing. Evidence of connection with the Masonic Order and information regarding financial need must be given with the application which must be submitted to the Secretary of the Faculty on or before October 15th.

"SECOND MILE ENGINEER" AWARD

The Class of 3T5, convinced that a successful engineer must not only be professionally competent but also constantly aware of his responsibilities to humanity, and inspired by an address of President William E. Wickenden of the Case School of Applied Science, Cleveland, called "The Second Mile", which was based on the text from the Sermon on the Mount, "whosoever shall compel thee to go one mile, go with him twain" has established the "Second Mile Engineer" award. It is the desire of the donors to encourage undergraduates to participate fully in extra-curricular activities and to recognize the true importance of the more liberal subjects of the curriculum with the ultimate objective, on entering their profession, of becoming worthy Second Mile Engineers. The award comprises a grant of $200.00, a suitably inscribed presentation piece and an illuminated scroll, and is presented to a student in his final year.

An eligible group is chosen from those who have taken a prominent part in the affairs of the Faculty, either as office holders or in athletics. In making the award consideration is given to academic standing, with special emphasis on the candidate's attainments in the cultural and humanistic-social studies. The subjects which are stressed are English of the First Year; Economics of the Second Year; and Political Science and Modern World History of the Third Year.

Particulars are furnished each session by the Class of 1935.

THE SIMPSON-SEARS LIMITED (NORTHERN ONTARIO) SCHOLARSHIPS

These scholarships, the gift of Simpson-Sears Limited, are open only to students of the Copper Cliff High School, The Sudbury High and Technical Schools, the Sturgeon Falls High School, the North Bay Collegiate Institute and Vocational School, the Kapuskasing High School

and all the Secondary Schools along the Ontario Northland Railway. A scholarship of the value of $100 is available for each of the schools mentioned and an additional sum of $50 will be given to the student who obtains the highest percentage of the nine papers of Grade XIII selected in accordance with the regulations.

No scholarship will be awarded unless the candidate is in actual attendance in one of the colleges or faculties of the University and maintains a uniformly high standard to the satisfaction of the donors of the scholarships.

Application for these scholarships must be sent not later than May 15th, to the Principal of the North Bay Collegiate Institute and Vocational School, from whom further information may be obtained regarding conditions of award.

SMITH AND STONE LIMITED BURSARIES

Smith and Stone Limited, Georgetown, Ontario, have provided five Bursaries, each of a possible value of $600 and each payable at the rate of $150 per year to assist deserving students from the Georgetown High School.

The award is made annually by the Senate on the recommendation of the Council of the Faculty to a student:

(*a*) who attended Georgetown High School for at least 2 years and is recommended by the Principal;

(*b*) who has met in full the admission requirements of the Faculty, first class honours not being a requirement.

To be eligible for continued enjoyment of the Bursary the holder must maintain satisfactory academic standing but not required to obtain honour standing.

The award was offered for the first time in the Session 1952–53.

SOCIETY OF CHEMICAL INDUSTRY MERIT AWARD

The Society of Chemical Industry Merit Award is made annually by the Society to the student in Fourth Year in the Department of Chemical Engineering who obtains the highest weighted average of marks in the results of the annual examinations for the year. The award is a gold key.

THE SPECIFICATION WRITERS ASSOCIATION SCHOLARSHIP IN CIVIL ENGINEERING

Donated by the Toronto Chapter of the Specification Writers Association of Canada, this scholarship has a value of $250 and is awarded to a student who achieves high standing, with honours, in the annual examinations of the Third Year in Civil Engineering.

The first award of this scholarship was made in the Session 1961–62.

SPRUCE FALLS POWER AND PAPER COMPANY LIMITED SCHOLARSHIPS

The Spruce Falls Power and Paper Company Limited has established four Scholarships of a value of $400.00 each, two in the Second Year and two in the Third Year. They are awarded on the results of the Annual Examinations of the Second and Third Years to the students who obtain honour standing at the examinations of their respective years

and are open to students in all courses in the Faculty. The first awards were made on the results of the examinations of 1951.

Each scholarship carries a grant of $150 to the University General Funds.

WALTER STERLING ADMISSION SCHOLARSHIPS

Established in memory of Walter Sterling, these scholarships are open to students entering any first degree course at the University of Toronto. Recipients must obtain First Class Honours standing on the nine Ontario Grade XIII papers required for admission, and may continue to enjoy the scholarships in each year of their course providing they maintain Honour standing. The value of the scholarship is from $200.00 to $1,500.00 annually, dependent on financial need. The number of awards made each year is determined by the annual income available.

Application should be made to the Registrar of the University on the regular scholarship application form. The statement of financial need should be completed if an award greater than $200.00 is desired.

THE WILLIAM STORRIE MEMORIAL SCHOLARSHIPS
IN CIVIL ENGINEERING

Three Scholarships have been established by Mrs. William Storrie in memory of her husband, the late William Storrie, a Consulting Engineer on many municipal projects in Canada and for several years a special lecturer in the Faculty of Applied Science and Engineering, for students in Civil Engineering, as follows:

(a) Of a value of $100.00 to the student completing his Second Year in Civil Engineering with the highest aggregate standing in the subjects of Calculus, Engineering Chemistry, Mechanics of Materials, and Surveying.

(b) Of a value of $100.00 to the student completing his Third Year in Civil Engineering with the highest aggregate standing in the subjects of Cements and Concrete, Structural Engineering, Engineering Problems and Drawing, and Hydraulics.

(c) Of a value of $200.00 to the student completing his Fourth Year in Civil Engineering with the highest aggregate standing in the subjects of Hydraulics, Municipal Administration and Contracts, Sanitary Engineering, and Thesis and Public Speaking.

In all cases the candidates shall have demonstrated qualities of integrity and shown promise of leadership in their profession.

The first awards were made for the Session 1956–57.

STUDENTS' ADMINISTRATIVE COUNCIL ADMISSION SCHOLARSHIP

The Students' Administrative Council Admission Scholarship of the annual value of $300, the gift to a student who (*a*) resides within the District of Manitoulin, or within that part of the Province of Ontario which lies north of the forty-sixth parallel of latitude excluding the cities of North Bay, Sudbury, Sault Ste. Marie, Port Arthur and Fort William; (*b*) obtains the highest average standing in first class honours in the nine papers of Grade XIII prescribed for admission to the course

which he desires to enter: and (*c*) who enrols in one of the following faculties: Medicine, Applied Science and Engineering, Forestry, Dentistry, in the School of Architecture, or in the Four-Year Course leading to the degree of Bachelor of Science in Pharmacy.

The scholarship is tenable for two years provided that the holder obtains an average of at least sixty-six per cent. at the annual examinations of the First Year. Application must be made to the University Registrar not later than May 1st.

THE TRANE COMPANY OF CANADA LIMITED PRIZE

The Trane Company of Canada Limited has established an annual Prize of $200.00 in the Faculty of Applied Science and Engineering. The recipient may be registered in the Fourth Year in any course and the Prize will be awarded for the best Thesis on air-conditioning or refrigeration, either for comfort cooling or industrial use.

This award is tenable with other awards in the gift of the Senate. Application is not required.

EDITH TYRRELL MEMORIAL BURSARY

The Women's Association of the Mining Industry of Canada has presented this Bursary, having the value of Five Hundred Dollars, annually, commencing in 1939, and named in memory of their founder and first president, Mrs. Edith Tyrrell. A medal donated by Dr. Tyrrell accompanies the Bursary. The Bursary is awarded to a student entering the Third or Fourth Year in the Course in Mining Engineering, Metallurgical Engineering, or Applied Geology; it may be awarded two years in succession to the same student, but will usually be awarded at the beginning of the Third Year. The award will be made by a special committee appointed by the Association on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

S. UBUKATA FUND

The S. Ubukata Fund for Japanese Students, the gift of the late S. Ubukata, provides for the establishment of scholarships, bursaries, medals, prizes, and loans for students from Japan proper attending the University of Toronto or one of its federated or affiliated colleges. An applicant for a scholarship, bursary or loan must be in good standing and have completed the first year of the work of the faculty or department in which he is registered. An occasional student must obtain a certificate from the head of the college or dean of the faculty concerned that full time is being devoted to his or her studies. A student is not eligible who is at the time in receipt of aid or support from any other institution,

religious or otherwise, in this country or in Japan or who already holds a scholarship or fellowship in the University. Application must be made to the University Registrar on or before December 1st.

UNIVERSITY OF TORONTO ALUMNI ASSOCIATION
WAR MEMORIAL SCHOLARSHIPS

Six scholarships are awarded annually by the University of Toronto Alumni Association to students entering first degree courses at the University of Toronto. The scholarships have a value of $500.00 annually, and are tenable for two years, providing satisfactory academic standing is maintained. They are awarded for general proficiency in Grade XIII, and in addition to academic performance the committee of award will take into consideration the candidate's relationship to active service in the Armed Forces of Canada, need of financial assistance, participation in extra-curricular activities and such other qualifications as may commend themselves to the committee. One scholarship will be available to a student whose home is not in the Province of Ontario.

Students resident in Ontario may apply on the general admission scholarship form which must be submitted to the Registrar of the University not later than May 1. Evidence of relationship to active service in the Armed Forces of Canada should be attached. Students resident out side Ontario may obtain the necessary forms from the Awards Department, Office of the Registrar, University of Toronto.

UNIVERSITY NAVAL TRAINING DIVISION BURSARIES

The University Naval Training Division Bursaries, the gift of the University Naval Training Division, are of the value of $100 each. As many as three bursaries may be awarded in each session; if fewer than three are awarded those not awarded may be given in a subsequent session. A candidate must be registered in the University for a full-time course leading to a diploma or degree and must be at the time of the award a member of one of the recognized military training units within the University. Application must be made to the University Registrar before the end of November.

UNIVERSITY OF TORONTO GENERAL BURSARIES

The Board of Governors has established a fund to provide bursaries for deserving students who without financial assistance cannot continue their formal education. Further information may be obtained from the Secretary of the Faculty.

THE U.T.S. ENGINEERING SCHOLARSHIP

The U.T.S. Engineering Scholarship, the gift of R. A. Bryce, Esq., of the value of $250. The scholarship will be awarded by a committee of the Staff of the University of Toronto Schools to a student of the Schools who has completed the requirements for admission to and enrols in the Faculty of Applied Science and Engineering.

WALLBERG ADMISSION SCHOLARSHIPS

Two admission scholarships, each of a value of $500.00 are awarded annually from the income from the Wallberg Bequest on the recom-

mendation of the Council of the Faculty to the two candidates who obtain the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that this attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Applications must be submitted to the Registrar on the prescribed form by May 1st.

WALLBERG UNDERGRADUATE SCHOLARSHIPS

These scholarships, four in number, of the value of $500.00 each, derived from the Wallberg Bequest, are awarded annually; two to students ranking first and second respectively at the annual examinations of the First Year; one to the student ranking first at the annual examinations of the Second Year; and one to the student ranking first at the annual examinations of the Third Year.

Any holder of one of these scholarships may not hold other awards listed in the Calendar with an asterisk. The awards were first made on the result of the annual examination of 1947.

W. S. WILSON MEDALS

These medals have been provided in recognition of the service to the Faculty of Applied Science and Engineering of its former Assistant Dean and Secretary, William Stewart Wilson.

A medal will be awarded to the student in each graduating course, who, attaining Honours, achieves the highest standing in the final year of his course.

The first awards were made in the Session 1962–63.

WILLIAM R. WORTHINGTON MEMORIAL SCHOLARSHIP

The William R. Worthington Memorial Scholarship, the gift of Miss Ida R. Worthington, in memory of her brother, William R. Worthington, Dip.(1904), B.A.Sc.(1905), of the value of the income from a fund is awarded annually to the student of the Second Year in the course in Civil Enginering who ranks highest at the anual examinations of that year.

The first award was made at the examinations for the Session 1954–55.

LOAN FUNDS

From the loan funds mentioned below, small loans can be made to students who are in urgent need of assistance. The funds are not large

and the loans must accordingly be restricted, both in amount and number, and principally to students in the Third and Fourth Years.

Enquiries for loans from any of the following funds should be made at the office of the Secretary of the Faculty.

- Engineering Alumni Loan Fund
- Engineering Society Loan Fund
- Elizabeth Speller Memorial Fund
- James W. Crocker Memorial Fund
- Harry F. Bennett Educational Fund
- S.A.E.—Canadian Section Loan Fund
- Class of 2T7 (SPS) Memorial Loan Fund
- Avro Aircraft Limited Engineering Loan Fund
- Association of Professional Engineers Loan Fund
- The William Storrie Memorial Fund
- 3T6 Engineers Loan Association
- 4T0 Engineering Loan Fund
- Women's Association of the Mining Industry in Canada Loan Fund
- The Devonshire Loan Fund
- Class of '09 Trust Fund
- University of Toronto Alumni Loan Fund

CLASS OF 1936 LOAN ASSOCIATION

Members of the Class of 1936 have made arrangements to assist students in obtaining loans through regular banking facilities. Information may be obtained from the Secretary of the Faculty.

ENGINEERING ALUMNI LOAN FUND

The Engineering Alumni Association established in 1950 a loan fund to assist engineering students, especially in the Third and Fourth Years.

Applications for loans from this fund should be made to the Secretary of the Faculty.

CLASS OF 2T7 (SPS) MEMORIAL LOAN FUND

This fund was established in 1955 to memorialize the Class of 1927 of the Faculty of Applied Science and Engineering.

Loans to a total of $250 are available to any undergraduate who has completed one Year, with or without conditions, and who has qualified for the Second, Third or Fourth Year.

Application shall be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary of the Faculty.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller, of the Class of 1893, the "Elizabeth Speller Memorial Fund" has been established to provide loans for worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

JAMES W. CROCKER MEMORIAL LOAN FUND

This fund was established by Mrs. William Crocker in memory of her son, James W. Crocker, a graduate in Mining Engineering in 1938, who was killed in an accident in a mine in the same year.

HARRY F. BENNETT EDUCATIONAL FUND

This fund was established by subscription from members of The Engineering Institute of Canada in memory of the late Harry F. Bennett, M.E.I.C., who for six years prior to his death in 1946 was chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, and who accomplished so much in this field by untiring efforts.

One purpose of the fund is to make loans to deserving students who need financial assistance to enable them to study engineering sciences at university level, and who have proved themselves by successfully completing their first year in engineering or the equivalent.

Loans will be made largely on the basis of character and to men who seem likely to develop the high professional standards which are essential to leadership in engineering science. A student who has been aided by this fund should feel that high obligations are placed on him; obligations to the subscribers, to the trustees, and to those coming after him who in turn can receive help as his loan is repaid.

Application forms may be obtained at the Faculty Office. The regulations are simple and the application of any worth-while student will be given immediate and careful attention.

SOCIETY OF AUTOMOTIVE ENGINEERS—CANADIAN SECTION LOAN FUND

The Society of Automotive Engineers—Canadian Section has established a loan fund of $1,200.00 in the Faculty of Applied Science and Engineering. Preference is given to students in good scholastic standing and engaged in studies relative to the automotive and aircraft industries, and to students in fourth, third and second years in that order. Particulars may be obtained from the Secretary of the Faculty.

AVRO AIRCRAFT LIMITED ENGINEERING LOAN FUND

Avro Aircraft Limited has established a Loan Fund of $3,000.00 to provide loans to engineering students requiring financial assistance. Application should be made to the Secretary of the Faculty.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO LOAN FUND

The Association of Professional Engineers has made loans not exceeding $200 available to students in the First, Second and Third Years in this Faculty. Application should be made to the Association at 236 Avenue Road, Toronto.

THE WILLIAM STORRIE MEMORIAL FUND

The William Storrie Memorial Fund has been established by Mrs. William Storrie to provide loans to undergraduates in the course in Civil Engineering. Application should be made to the Secretary of the Faculty.

THE DEVONSHIRE LOAN FUND

This Fund has been established by Graduates and friends of Devonshire House to assist students in the Residence. Application should be made to the Office of the Dean of Devonshire House.

CLASS OF '09 TRUST FUND

The Class of '09 on the 50th Anniversary of their graduation made a sum of money available in the Faculty for financial aid to undergraduates, with preference to Second Year students. Inquiry should be made to the Secretary of the Faculty.

THE UNIVERSITY OF TORONTO ALUMNI LOAN FUND

This fund comes from subscriptions received originally in 1919 and in succeeding years from graduates of the University and is administered by the University of Toronto Alumni Association.

Loans are available to undergraduate and graduate students enrolled in a full time course at the University, in second and subsequent years.

Particulars may be obtained from The University of Toronto Alumni Association, Alumni House, 18 Willcocks Street, Toronto, or from the Secretary of the Faculty or School.

GRADUATE SCHOLARSHIPS AND FELLOWSHIPS

ALUMINIUM LABORATORIES LIMITED FELLOWSHIP

The Aluminium Laboratories Ltd. have established a fellowship valued at $1100.00 or $1800.00 (8- or 11-month tenure) plus fees. This award will be held in the School of Graduate Studies by a candidate for a Master's or a Doctor's degree in the fields of mathematics or physical sciences, pure or applied, preference being given to students in the field of physical metallurgy.

THE ATHLONE FELLOWSHIPS

Her Majesty's Government in the United Kingdom has established a number of fellowships to be awarded annually to enable Canadian engineering graduates to take postgraduate training in the United Kingdom. These became available in 1951 when five fellowships were open to graduates of the University of Toronto immediately after graduation. Additional fellowships are for award to graduates who have already spent some time in industry. The fellowships cover costs of transport, fees and maintenance and are normally tenable for a period of two years. They may be utilized for (*a*) works training in industry, (*b*) postgraduate university study, or (*c*) a combination of these. Candidates must be Canadian citizens or British subjects normally resident in Canada and should preferably be less than 27 years of age. Further information and application forms may be obtained from the Secretary of the Faculty.

J. P. BICKELL FOUNDATION FELLOWSHIPS

These fellowships are open to students registered in the School of Graduate Studies and pursuing studies in Metallurgical Engineering or Geological Sciences. Applications must be submitted to the Secretary of the School of Graduate Studies not later than March 1.

THE C.I.L. FELLOWSHIPS

Two Fellowships, the gift of Canadian Industries (1954) Limited, of the value of $2,000 each are established for the encouragement of postgraduate work in Chemistry. An applicant must be a university graduate who is a Canadian citizen or a graduate who intends to follow a career in Canada, with preference to Canadian citizens. The holders of these Fellowships will be required to undertake research in any branch of Chemistry under the direction of the department designated by the Committee of Award. Application must be made, with full statement of qualifications and testimonials, to the Secretary of the School of Graduate Studies not later than March 1st.

CANADIAN LUMBERMEN'S ASSOCIATION TIMBER RESEARCH FELLOWSHIP

This fellowship, donated by the Canadian Lumbermen's Association, is offered to encourage advanced study and research in timber engineering. It is open to graduates in engineering and graduates in forestry of

any recognized university. The fellow must be registered in the School of Graduate Studies as a student proceeding to a post-graduate degree and must carry out a prescribed programme of study and research in both engineering and forestry. It is intended that the work of this programme will extend over a period of two academic years. The annual value of the fellowship is $1,250, all of which might not be granted to one student.

Application should be made to the Secretary of the School of Graduate Studies not later than September 1st and should be accompanied by an official transcript of the applicant's undergraduate record, together with a statement of his experience in the forestry and construction fields.

COMMONWEALTH SCHOLARSHIPS

Under a Plan drawn up at a conference held in Oxford in 1959, each participating country of the Commonwealth offers a number of scholarships to students of other Commonwealth countries. These scholarships are mainly for graduate study and are tenable in the country making the offer. Awards are normally for two years and cover travelling, tuition fees, other university fees, and a living allowance.

For details of the awards offered by the various countries consult the Registrar's Office, or write to The Canadian Universities Foundation, 77 Metcalfe Street, Ottawa.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIPS

The Royal Commissioners for the Exhibition of 1851 have invited the University of Toronto to recommend annually one or more candidates in order of merit for science research scholarships, each of the value of £350 per annum and ordinarily tenable for two years. The Commissioners may make a supplementary grant up to £50 per annum for University fees, etc., payable by the scholar during his tenure of the award.

Each candidate recommended must be a British subject, and under twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University, the students of which are eligible to apply for these scholarships: 1. Bacteriology;

2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geological Sciences; 13. Physics; 14. Physiology; 15. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the university, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board is appointed by the Senate and has power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than March 1st to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

THOMAS H. HOGG OVERSEAS FELLOWSHIP

This fellowship was established by Mrs. T. H. Hogg in 1962, in memory of the late Thomas H. Hogg, B.A., C.E., D.Eng., an honour graduate of the Faculty of Applied Science and Engineering. It is to be awarded to a Canadian candidate for study, beyond the North American continent, in the field of hydraulics, fluid mechanics or power system engineering.

Annual value of the fellowship is $2,250.00 with an allowance for travel and tuition to a maximum of $750.00. Application should be made before January 1st to the Dean, Faculty of Applied Science and Engineering.

IMPERIAL OIL GRADUATE RESEARCH FELLOWSHIPS

Imperial Oil Limited in 1946 established for annual competition Graduate Research Fellowships, now five in number and having a potential value of $4,800 each ($1,600 a year for a maximum of three years). Each fellowship may be supplemented by an annual amount of $900 if the fellow continues his thesis work during the summer months. A fellow may not hold concurrently other awards which annually equal or exceed the value of the regular Imperial Oil payments ($1,600).

The fellowships are open to any graduate of any approved Canadian university and are offered for research leading to a Doctor's degree in the fields of Chemistry, Physics and/or Engineering (2 fellowships), Geology (1 fellowship), Economics, Psychology, Sociology, or Business Administration (1 fellowship) and Humanities such as English, Ancient and Modern Languages, History, or Philosophy (1 fellowship). Nomination of students for the fellowships is made by the university—such nominations to be received by the Secretary, Imperial Oil Scholarship Committee, Imperial

Oil Limited, 111 St. Clair Avenue West, Toronto 7, not later than March 1st of each year.

THE INTERNATIONAL NICKEL GRADUATE RESEARCH FELLOWSHIPS

The International Nickel Company of Canada has established a number of Graduate Research Fellowships, to promote and encourage research in the technical fields serving the Canadian metal industries and to further public interest in industrial science in Canada. Each has a possible tenure of three years with an annual payment of $2,500, of which $2,000 is payable to the fellow and $500 is placed at the disposal of the directing professor for necessary materials or equipment. It is expected that four new fellowships will be awarded in 1961.

Applications on behalf of competent graduate students will be considered from any Canadian university qualified to confer the Master's or Doctor's degree in Geology (including Geophysics), Mining, Ore Dressing, Metallurgy (both process and physical), Chemistry (pertaining to metals), Physics (pertaining to metals), and Mathematics. Awards are made by a committee appointed by the National Conference of Canadian Universities and Colleges.

Application should be made to the International Nickel Company of Canada, Limited, 55 Yonge Street, Toronto 1, Ontario, not later than February 14.

THE JOHNSON FOUNDATION SCHOLARSHIP AWARD

The Johnson Foundation through S. C. Johnson and Son Limited, Brantford, Ontario, offers one scholarship each year for study in a United States College or University in postgraduate fields of study such as economics, business administration, chemistry, engineering, teaching, etc. The amount of the scholarship varies according to the requirements of each student.

Further information may be obtained from S. C. Johnson and Son Limited, Brantford, Ontario, and preliminary application must be received by them not later than December 15th.

MCCHARLES PRIZE

This prize, the gift of the late Æneas McCharles of the value of $1,000, is awarded from time to time but not necessarily every year on the following terms and conditions: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions determine the method of award.

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000) in money.

(3) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(4) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE UNIVERSITY OF MANCHESTER TORONTO FUND

The University of Manchester has accepted the gift of a sum of £1,699 from a Committee representing the parents of children who during the war were evacuated to Toronto and other places in Canada. The capital and any income arising therefrom will be used to make grants to Canadians wishing to conduct post-graduate studies and/or research in the University of Manchester, preference being given to students who have graduated from the University of Toronto. The total amount of grant or grants to any student will not exceed £100. Applications must be submitted to the Registrar of the University of Toronto on or before January 1st of the year in which the applicant wishes to enter the University of Manchester, together with transcripts of undergraduate and graduate record and outlines of the post-graduate studies and/or research to be followed at the University of Manchester.

NATIONAL SEWER PIPE COMPANY LIMITED SCHOLARSHIP

The National Sewer Pipe Company Limited has established a scholarship of a value of Five Hundred Dollars ($500.00) in the School of Graduate Studies. It is awarded annually to a student who undertakes to enroll in that School, proceeding to the degree of Master of Applied Science in the graduate Department of Civil Engineering and in the course in Public Health Engineering.

Applications must be submitted to the Secretary of the School of Graduate Studies on or before March 1st.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering, to be known as The Nipissing Mining Company Research Fellowship, of the annual value of the income from the fund, plus free tuition.

This Fellowship is open to graduates of any University.

H. W. PRICE RESEARCH FELLOWSHIP IN ELECTRICAL ENGINEERING

The H. W. Price Research Fellowship in Electrical Engineering consisting of the income or a part thereof but not exceeding the income for three years derived from the sum of $10,000 donated by the Hydro Electric Power Commission of Ontario, will be awarded from time to

time as recommended by the School of Engineering Research, to a graduate in Electrical Engineering of any recognized University, registered in the School of Graduate Studies, wishing to proceed with an investigation in the field of Electrical Engineering.

Forms of application may be obtained from the Secretary, School of Graduate Studies, and should be returned with a statement of qualifications not later than March 1st. The first award was available in 1943.

THE RAYMOND PRIESTLEY FELLOWSHIP

The University of Birmingham being "anxious to mark its indebtedness and its gratitude" for the hospitality shown during the Second World War to children of members of its teaching staff by members of the University of Toronto, has set aside a research fellowship to be held by a graduate of the University of Toronto. This fellowship, to be known as the Raymond Priestley Fellowship, of the value of £450 per annum as well as the cost of the return passage from Canada, is available for graduates, both men and women, preferably those who have already shown some capacity for and interest in research. The fellowship will normally be awarded for a period of three years. It is tenable in any faculty of the University of Birmingham. The Fellow will undertake research and may, if he wishes, be a candidate for a higher degree at the University of Birmingham. The selection of the candidate will be made by the University of Toronto. The process of selection will include negotiation with the head of the department concerned in the University of Birmingham to ensure that there is in the University opportunity for the pursuit of the particular line of research required. Applications must be submitted to the University Registrar not later than March 1st, together with transcripts of undergraduate and graduate records and outlines of the research to be undertaken at the University of Birmingham.

THE ROYAL INSTITUTION OF GREAT BRITAIN SCIENCE RESEARCH SCHOLARSHIPS

A scholarship of the value of £350 per annum with a possible additional allowance of £50, to be held ordinarily for a period of two years, will be offered each year to a candidate from one of the universities of Canada, Australia, New Zealand and South Africa, and is tenable only in the Davy Faraday Research Laboratory of the Royal Institution, London. No candidates will be considered except those who have been recommended for the 1851 Exhibition Science Research scholarships, and candidates who wish to be considered also for the Royal Institution scholarships are requested to state this clearly in the application for an 1851 scholarship. No other application to the Royal Institution is necessary. Copies of the regulations relating to these scholarships may be obtained from the University Registrar.

THE STEEL COMPANY OF CANADA LIMITED FELLOWSHIPS IN METALLURGY

Four Fellowships, each of the value of $3,000, out of which $2,000 will be awarded to the successful candidate and $1,000 to the university at

which he or she studies, are offered to permanent residents of Canada who are graduates of a Canadian university. The fellowships are normally tenable for one year but in special circumstances may be renewed for a second year. Applications must be made in triplicate on the approved form to The Secretary, Canadian Universities Foundation, 77 Metcalfe Street, Ottawa. Forms may be obtained from the relevant department in your university, from the Registrar's office, or from the above address.

SPRUCE FALLS POWER AND PAPER COMPANY, LIMITED, FELLOWSHIP

The Spruce Falls Power and Paper Company Limited has established a Fellowship for the encouragement of research in the Faculty, of an annual value of $1200. It is open to graduates of the University of Toronto or of other recognized universities, but is restricted to Canadian Citizens. Application should be sent to the Secretary of the School of Graduate Studies, not later than March 1st.

The Fellowship also carries a grant of $300 to be applied to the tuition of the holder and $300 to the general University Funds.

THE 1940 TORONTO FUND

The 1940 Toronto Fund, the gift of Oxford University, of the value of £3000, was set up in 1940 by the parents of Oxford children who were taken into Canadian and American homes during the War. Recommendations for grants from the Fund will be made from time to time by the Senate of the University of Toronto to members of the University "who wish to go to Great Britain for the purpose of study, research, or any general educational purpose, taking education in the widest possible sense." Each applicant for a grant from this Fund must submit his application to the University Registrar not later than March 1st together with an outline of the study or research which he proposes to undertake in Great Britain, or the general educational purpose which he has in mind in going there.

WALLBERG RESEARCH FELLOWSHIPS

Three Wallberg Research Fellowships, each of the value of $2,000 and fees up to $300, are open to graduates of any recognized university who propose to pursue advanced study and research in any branch of Engineering in the University of Toronto.

Forms of application may be obtained from the Secretary of the School of Graduate Studies. These should be returned together with a transcript of academic record and an outline of the proposed study and research not later than March 1st.

THE CHARLES G. WILLIAMS FELLOWSHIP IN URANIUM METALLURGY

Eldorado Mining and Refining Limited offers a postgraduate scholarship in Uranium Metallurgy to a graduate in the physical sciences, pure and applied of a value of $1,500 for an academic year and the holder is also eligible for a supplementary amount of $800 for the summer months. A cash grant to the University accompanies the fellowship.

Application forms may be obtained from the Registrar of the University and submitted to the Secretary, Eldorado Mining and Refining Limited, P.O. Box 379, Ottawa, Ontario, before 15th March.

GARNET W. MCKEE LOAN AND SCHOLARSHIP FUND

The late Mrs. Garnet W. McKee has given this fund to assist students of promise at the University of Toronto, and to develop and extend by research the following subjects studied in the Engineering Physics course in the Faculty of Applied Science and Engineering, especially in their application to the industries of Canada: Electricity and Communications; X-rays and Spectroscopy; Illumination and Acoustics; Geophysics; Refrigeration; Aeronautics.

In each session $800 from the annual income of the fund will be allotted to provide the Garnet W. McKee Scholarship, tenable preferably by a graduate who was eligible for a loan in a previous session, or who is in at least the second year of his graduate work.

Each holder of the said Scholarship and each graduate to whom a loan is granted will be required in the following session to enrol in the School of Graduate Studies and to pursue studies leading to a graduate degree in one or more of the subjects listed, and he may not engage in remunerative employment during the session except by permission of the Committee of Award.

Applications for a loan must be made to the Secretary of the School of Graduate Studies not later than September 1st.

Applications for a scholarship must be accompanied by an outline of the proposed research problem.

SECTION XI. DISCIPLINE

1. Subject to the general regulations of the Caput of the University regarding jurisdiction in matters of discipline the Council of University College, the governing bodies of the Federated Universities and Affiliated Colleges, and the Councils of the Faculties, Schools, and Institutes have disciplinary jurisdiction over the conduct of all students registered in these Divisions of the University in all matters of local or internal concern to these Divisions. Jurisdiction over the conduct of students while in residence regardless of the Division of the University in which they are registered is vested in the body administering the residence.

2. Jurisdiction concerning conduct likely to affect the interests of the University as a whole is vested in the Caput.

3. The Students' Administrative Council will be supported in the proper performance of all its obligations and duties as provided in its Constitution.

4. Where the appropriate body exercising disciplinary jurisdiction has found that a student of the University has engaged in conduct prejudicial to the interests of the University, the Caput may, in its discretion, suspend or expel such student from the academic privileges of the University. Every decision of the Caput involving the expulsion of a student from the University requires confirmation of the Board of Governors.

5. Any student who interferes with the personal liberty of another or who subjects another student to indignity or personal violence may be considered by the Caput or any other body exercising disciplinary jurisdiction in the University to have committed a breach of discipline.

6. Initiation ceremonies involving physical violence, personal indignity, interference with personal liberty, or destruction of property, may be deemed a breach of discipline by the Caput or any other body exercising disciplinary jurisdiction in the University.

7. Without limiting the disciplinary powers vested in the respective bodies exercising disciplinary jurisdiction as set forth in sections 1–7, the following are cited as illustrations of conduct which, in the past, has been considered a breach of discipline prejudicial to the interests of the University:

- (i) The organising of a parade on the streets of the city or the taking part in such a parade without permission of the authorities.
- (ii) The destruction or defacing of University property, raids on Residences or other University buildings, and the breaking into University buildings.
- (iii) Rowdy and other forms of behaviour, either on or off the Campus, of such an objectionable nature as to bring the University into public disrepute.

8. Student Clubs and Associations

(a) The constitution of every society or association of students in the University and all amendments to such constitutions require to be approved by the relevant University authorities. The giving of approval, and the responsibility for the programmes of student societies and associations, shall rest as follows:

(i) With the authorities of the College, Faculty or School concerned where the membership of the student society or association is drawn from a single College, Faculty or School.

(ii) With the Board of Stewards of Hart House, where the student society or association is a Committee of Hart House and is controlled by the Board of Stewards of Hart House.

(iii) With the Caput, in the case of all other student societies and associations.

(b) No approval will be given by any of the authorities listed in (a) above to the constitution of any society or association of students if that constitution permits:

(i) Membership in the society or association to persons who are not students of the University, unless in the case of the societies listed in (a) (ii) above, where membership is open also to graduates of the University and members of the Faculty of the University.

(ii) Any action of discrimination based upon race, religion, or colour.

9. The name of the University is not to be used in connection with a publication of any kind without permission of the Caput.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1962–63

Courses		1	2	3	4	5	6	7	8	9	Total
Year	I	71	7	64	20	114	75	85	9	8	453
	II	49	7	30	24	68	54	58	15	5	310
	III	37	3	44	23	48	46	61	5	4	271
	IV	60	5	63	16	65	49	57	9	7	331
TOTAL		217	22	201	83	295	224	261	38	24	1365
Special Students											7
											1372

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UNIVERSITY OF TORONTO

CALENDAR

Faculty of Applied Science and Engineering

1964-1965

UNIVERSITY OF TORONTO PRESS
1964

CALENDAR 1964

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SECTION 1. CALENDAR 1964–65

FALL TERM, 1964

July 1	*Wednesday*	Dominion Day. Buildings closed.
July 3	*Friday*	Last day for receiving applications for supplemental examinations.
August 3	*Monday*	Civic Holiday. Buildings closed.
August 10	*Monday*	Supplemental Examinations commence.
August 17	*Monday*	Students of the III Year, Course 1, report at Survey Camp.
August 24	*Monday*	Students of the III Year, Courses 2 and 9, and IV Year, Course 1 option B, report at Survey Camp.
September 7	*Monday*	Labour Day. Buildings closed.
September 9	*Wednesday*	Special Meeting of Faculty Council. Students in II Year, Course 6, report for Analytical Chemistry Laboratory.
September 17 September 18	*Thursday* *Friday*	Registration in person of the I Year from 9:30 a.m. to 12:00 noon and from 2:00 p.m. to 4:30 p.m. in the Galbraith Building.
September 21	*Monday*	Registration in person of the II and III Years from 9:30 a.m. to 12:00 noon and from 2:00 p.m. to 4:30 p.m. in the Galbraith Building.
		Dean's address to the I Year.
		Preliminary instruction to the I Year.
September 22	*Tuesday*	Registration in person of the IV Year from 9:30 a.m. to 12:00 noon, and from 2:00 p.m. to 4:30 p.m. in the Galbraith Building.
		Meeting of Faculty Council.
September 23	*Wednesday*	Lectures and Laboratory work commence at 9:00 a.m.
		Opening address by the President to the students of all Faculties at 3:45 p.m. in Convocation Hall. Lectures and Laboratory classes withdrawn from 3:00 p.m.
October 5	*Monday*	Meeting of Faculty Council.
October 9	*Friday*	Meeting of Senate.
October 12	*Monday*	Thanksgiving Day. Buildings closed.
November 4	*Wednesday*	Meeting of Faculty Council.
November 11	*Wednesday*	Remembrance Day Service 10:45 a.m. Lectures and Laboratory classes withdrawn from 10:00 a.m. to 12:00 noon.

November 13	*Friday*	Meeting of Senate.
November 27	*Friday*	Fall Convocation.
December 3	*Thursday*	Meeting of Faculty Council.
December 11	*Friday*	Meeting of Senate.
December 17	*Thursday*	First Year Term Examinations.
December 18	*Friday*	First Year Term Examinations. Term ends at 5:00 p.m.
December 25	*Friday*	Christmas Day.

SPRING TERM, 1965

January 1	*Friday*	New Year's Day.
January 4	*Monday*	Spring term begins. Mid session Examinations commence.
January 8	*Friday*	Meeting of Senate.
January 11	*Monday*	Meeting of Faculty Council.
January 15	*Friday*	Last day for receiving the second term instalment of fees.
January 21	*Thursday*	IV Year Employment interviews.
January 22	*Friday*	IV Year Employment interviews.
January 23	*Saturday*	IV Year Employment interviews.
February 3	*Wednesday*	Meeting of Faculty Council.
February 12	*Friday*	Meeting of Senate.
March 2	*Tuesday*	Meeting of Faculty Council.
March 12	*Friday*	Meeting of Senate.
April 2	*Friday*	Meeting of Faculty Council.
April 9	*Friday*	Term ends at 5:00 p.m. Meeting of Senate.
April 16	*Friday*	Good Friday. Buildings closed.
April 17	*Saturday*	Buildings closed.
April 19	*Monday*	Annual Examinations commence.
May 5	*Wednesday*	Meeting of Faculty Council.
May 14	*Friday*	Meeting of Senate.
May 24	*Monday*	Victoria Day. Buildings closed.
May 28	*Friday*	University Convocations
May 31	*Monday*	
June 1	*Tuesday*	
June 2	*Wednesday*	
June 3	*Thursday*	
June 4	*Friday*	
June 16	*Wednesday*	

SECTION II. ADMINISTRATIVE OFFICERS

1963–1964

THE UNIVERSITY

President . . . C. T. Bissell, M.A., Ph.D., D.Litt., LL.D. F.R.S.C.
Vice-President (Academic) . . . M. St. A. Woodside, M.A., LL.D.
Principal of Scarborough College and Vice-President for Scarborough and Erindale Colleges . D. C. Williams, M.A., Ph.D.
Executive Assistant to the President . . . . . J. H. Sword, M.A.
Special Assistant to the President for Secondary School Affairs P. A. C. Ketchum, M.A., B.Paed., LL.D.

Registrar . . . . R. Ross, M.B.E., M.A.
Chief Librarian . . . . R. H. Blackburn, M.A., B.L.S., M.S.
Director of University Extension . . . D. C. Williams, M.A., Ph.D.
Chairman of the Medical Sciences Advisory Council . . . . . M. St. A. Woodside, M.A., LL.D.

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Comptroller . . . . G. L. Court, D.F.C., M.Com., C.A.
Secretary of the Board of Governors . . . . . . D. S. Claringbold
Superintendent of Buildings and Grounds . F. J. Hastie, B.Sc., P.Eng.
Chief Accountant . . . . D. J. Reid

Director of the University of Toronto Press . . . M. Jeanneret, B.A.

Director of Alumni Affairs . . . . J. C. Evans, B.A.
Director of Information . . . . K. S. Edey
Director of Development . . . . R. J. Albrant
Director of Graduate Records . . . . . . C. G. M. Grier, E.D., M.A.

Warden of Hart House . . . . J. McCulley, M.A.
Director of University Health Service G. E. Wodehouse, M.C., M.D., F.R.C.P.
Assistant Director of University Health Service—Women Miss F. H. Stewart, B.A., M.D.
Director of the Placement and Housing Services J. K. Bradford, O.B.E., M.A.Sc.
Director of Athletics and Physical Education—Men . W. A. Stevens, B.S.
Director of Athletics and Physical Education—Women Miss Z. Slack, B.A.
Administrator, Students' Administrative Council R. S. Rawlings, B.A.
Director of Hart House Theatre . . . . R. S. Gill, M.A.

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING

Dean . . . . R. R. McLaughlin, M.A.SC., M.A., PH.D.
Secretary . . . . J. A. Gow, B.A.SC.
Assistant Secretary . . . . W. H. Sisson, B.A.SC.

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G. Parato, B.A.Sc.	18 Crang Avenue, 10
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R. L. Sakaguchi, B.A.Sc.	822 Carlaw Avenue, 6
O. G. A. Schmidt, B.A.Sc., M.A.Sc.	6 Honey Drive, Scarborough
C. G. Slinn, B.A.Sc.	511 MacDonald Rd., Oakville
R. H. Temple, B.A.Sc.	26 Rykert Crescent, 17
J. Unsworth, B.A.Sc.	27 Dalton Rd., 4
C. S. Wu, B.Sc.(Ordinance Eng. Col., Taipei)	54 Henry Street, 2B

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G. F. Hamilton, B.A.Sc., M.A.	18 Anglesey Blvd., Islington
R. T. Hartlen, B.Eng.(N.S. Tech.), M.A.Sc.	638 Bathurst Street, 4
D. M. Kaminker, B.A.Sc., M.S.(M.E.) (Polytechnic Inst. of Brooklyn)	209 Ava Road, 10
L. Y. Lau, B.A.Sc., M.A.Sc.	554 Huron Street, 5
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J. Peregrym, B.Sc.(Eng.) (Alta.)	Apt. 610, 437 Jarvis Street, 5
V. Sernas, B.A.Sc., M.A.Sc.	8 High Park Blvd., 3

DEPARTMENT OF METALLURGY AND MATERIALS SCIENCE

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Associate Professors

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S. N. Flengas, B.Sc.(Athens), D.I.C.(Lond.), Ph.D.(Lond.)	60 Overbank Cresc., Don Mills
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G. G. Charette, B.A.Sc.	14 Grandview
E. U. Chukukere, M.A.Sc.	53 Robert St.
T. Jubb, M.A.Sc.	59 Glenvale Blvd.
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R. L. Lister, M.A.Sc.	10 Shallmer Rd.
D. Mills, M.A.Sc.	605 Roehampton Ave.
G. L. Montgomery, M.A.Sc.	90 Castlefield Ave.
P. Niessen, M.A.Sc.	98 Trethewey Dr.
H. S. Ray, M.A.Sc.	38 Sussex Ave.

B. B. L. SETH, M.A.SC. 112 Baldwin
P. K. STRANGWAY, B.A.SC. 39 Blythwood Rd.
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A. A. Sonin, b.a.sc., m.a.sc. 185 Cosburn Ave.

D. Surry, b.a.sc. 37 Cork Ave.

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Special Lecturer in Engineering Law

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183 Three Valleys Dr., Don Mills
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A. Danielian, B.SC., PH.D.(NOTTINGHAM) (Visiting Physics)
16 Sussex St.
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R. A. Ross, m.a., ph.d. (Mathematics)	484 Church St.
D. K. Sen, m.sc., dr. ès sc. (Mathematics)	161 St. George St.
J. P. Valleau, m.a., ph.d. (cantab.) (Chemistry)	149 Collier St.
J. R. Vanstone, m.a., ph.d. (Mathematics)	139 Castlefield Ave.
C. W. Webb, m.a., ph.d. (Philosophy)	9 Southill Dr., Don Mills
B. H. Worsley, s.m. (m.i.t.), ph.d. (cantab.)	55 Glenavy Ave.
Miss M. Wonenburger, ph.d. (yale), dr.math. (madrid) (Mathematics)	26 Thorncliffe Ave.
D. York, b.a., d.phil. (oxon.) (Physics	515 Chaplin Cres.

SECTION IV. HISTORICAL SKETCH

The Legislative Assembly of the Province of Ontario during the Session of 1877 gave its sanction to the establishment of a School of Practical Science on the basis proposed in the memorandum of the Minister of Education confirmed by the Lieutenant-Governor in Council on the 3rd day of February, 1877.

By the scheme thus approved the Government effected an arrangement with the Council of University College whereby the instruction given by its professors and lecturers in all departments of science embraced in the work of the School was made available to students of the School. This arrangement was brought to an end in 1889 by the transfer of the departments of science, above referred to, from University College to the University of Toronto under the operation of the University Federation Act. In order that the students of the School might continue to enjoy the advantage of the instruction of the above departments, the Senate of the University of Toronto passed a statute in October, 1889, affiliating the School with the University. The statute was confirmed by the Lieutenant-Governor on the 30th day of October, 1889.

By an Order-in-Council, approved by the Lieutenant-Governor on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers, and Demonstrators appointed in the Teaching Faculty of the School.

On December 14th, 1900, the Senate, by statute subsequently approved by the Lieutenant-Governor in Council, established a Faculty of Applied Science and Engineering but without assuming any liability for its support or maintenance. Under this statute the teaching staff and examiners of the School of Practical Science became the teaching staff and examiners of the Faculty, although the University retained the right to appoint the examiners for the Bachelor of Applied Science and professional degrees. By the University Act of 1906 the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto.

On April 8th, 1892, the Senate of the University established the Degree of B.A.Sc., which was open to those who held the Diploma of the School and were prepared to devote a fourth year to advanced work. In the Session of 1909–1910 a new course extending over four years and leading to the Degree of B.A.Sc., came into operation, taking the place of the long established diploma course of three years, which came to an end in the Session 1910–1911. In the session 1923–24 the degree was changed to B. Arch. for the students graduating in Architecture. On July 1, 1948, the School of Architecture was separated from the Faculty and became an independent School with its own Director and Council.

With the end of the Second World War during the summer of 1945 the University was faced with the difficult problem of providing accom-

modation for almost double the number of students that had been registered in the previous year. Through the efforts of the Chairman of the Board of Governors and the President, the University leased from the Crown part of the large shell-filling plant at Ajax, twenty-five miles east of Toronto, to relieve the heavy demand for space at Queen's Park. Because it became evident, at an early stage, that a relatively large number of students would register in the Faculty of Applied Science and Engineering, it was decided that the work of the First and Second Years of this Faculty should be given at Ajax.

A special First Year session with approximately 1400 students commenced at Ajax on January 14, 1946. In the regular 1946–47 session both First and Second Year instruction, except Second Year in Architecture, was given at Ajax with 1800 registered in the First Year and 1500 in the Second Year. In the 1947–48 session the enrolment at Ajax consisted of 1200 students in the First Year and 1400 in the Second Year. In the session 1948–49, 600 were registered at Ajax in the First Year and 975 in the Second Year. All other instruction was given in Toronto.

To provide for this self-contained University community at Ajax, there were 446 acres and 111 buildings. The University operated such services as central heating, road maintenance, water supply, sewage disposal, fire department, transportation, post office, laundry, private hospital, cafeteria, tuck shop and barber shop. Former production-line buildings were altered to accommodate 37 lecture rooms, 20 draughting rooms and 14 laboratories. In the 1946–47 session, 2300 students were in residence, in 1947–48 there were 1800 students and in 1948–49 there were 900. Student life at Ajax compared favourably with that in Toronto, excellent accommodation being provided for a general circulating library, a technical library, Hart House Ajax, the Athletic Association, the Health Service, Students' Administrative Council, Advisory Bureau for Ex-Service Students, and a small chapel.

Meanwhile, the erection of the Wallberg Building and an addition to the Mechanical Building was in progress, and with this additional accommodation becoming available on the Queen's Park campus, Ajax was closed on May 31, 1949.

The long-felt need for additional space for Civil Engineering and Electrical Engineering, and the projected expansion of the University as a whole to meet the expected demand for greatly enlarged enrollment, led to the construction of the Galbraith Building. Partially occupied during the 1960–61 session it was officially opened on March 7th, 1961, by the Honourable J. Keiller Mackay, D.S.O., V.D., Q.C., LL.D., D.C.L., Lieutenant Governor of Ontario. The building houses Civil Engineering, Electrical Engineering, the Institute of Aerophysics, and the Faculty Office.

SECTION V. GENERAL INFORMATION, ADMISSION AND REGISTRATION

Inquiries about admission to this Faculty should be sent to the Registrar of the University.

RESTRICTION OF REGISTRATION

The right is reserved to limit the number of students admitted to any course in the Faculty.

1. ADMISSION REQUIREMENTS

A candidate for admission to the first year must present the Ontario Grade XIII certificate or an equivalent certificate showing standing in the following subjects:

English:	Literature Composition	
Mathematics:	Algebra Geometry Trigonometry	
Science:	Chemistry Physics	
One of:	French German Greek Italian Latin Spanish Russian	*Authors and Composition*

For admission to Civil, Mining, Mechanical, Industrial, Chemical, Electrical and Metallurgy and Materials Science, and to Applied Geology, an overall average of at least 64% on these subjects is required.

For admission to Engineering Science, an overall average of at least 70% on these subjects is required. Further information concerning the course in Engineering Science will be found on page 47 of this calendar. Students intending to pursue work in Aerospace Engineering will register in Engineering Science. For further information, refer to page 47 and 65.

Preferential consideration will be given to candidates who have completed the University admission requirements at the end of one session in Grade XIII in Ontario schools or in one sitting in other school systems. Applications will also be considered in the light of the Principal's Report, the previous school record of the applicant and other tests of the student's ability that are available.

2. EQUIVALENT CERTIFICATES

The following certificates are usually accepted as equivalent to Ontario Grade 13 although individual subjects cannot always be equated. Standing in the following certificates is required as outlined in (1) above. Specific details on the standing required from applicants who have not been educated in Ontario will be supplied by the Department of Admissions, Office of the Registrar, on request.

CANADA:

Alberta, Manitoba, Nova Scotia, Saskatchewan—Grade 12.
British Columbia, New Brunswick—Senior Matriculation.
Newfoundland—First Year Memorial University.
Prince Edward Island—Third Year Certificate of Prince of Wales College.
Quebec—Senior High School Leaving Certificate; McGill Senior School Certificate; English Catholic Senior High School Leaving Certificate (5th Year High—Grade XII).

ENGLAND, WEST INDIES, EAST AND WEST AFRICA:

(i) General Certificate of Education showing either
   (a) Passes in five subjects of which at least two must be passed at advanced level; or
   (b) Passes in four subjects of which at least three must be passed at advanced level.

   In either case, passes are required in Physics, Chemistry, and an acceptable mathematical subject. At least two of these must be at advanced level.

or (ii) School and Higher School Certificates, which are equated to the General Certificate of Education as follows, and accepted on that basis:

   Credits on the School Certificate are accepted as ordinary level passes on the General Certificate of Education; subsidiary passes on the Higher School Certificate as ordinary level passes on the General Certificate of Education; and principal or main subject passes on the Higher School Certificate as advanced level passes on the General Certificate of Education.

HONG KONG:

General Certificate of Education or School and Higher School Certificates as stated above; or University of Hong Kong Matriculation Certificate, accepted on same basis as General Certificate of Education.

UNITED STATES OF AMERICA:

First Year University credits (a minimum of 30 semester hours) in the required subjects from accredited institutions of higher learning. A United States High School Graduation Diploma will not admit a candidate to any course.

Candidates seeking admission on the basis of certificates which are in a language other than English must submit photostatic copies of their certificates, rather than the original copies. Notarized English translations of the certificates must accompany the photostatic copies. When the certificates do not indicate the subjects studied and the grades secured in the individual subjects in the final year, candidates are required to submit certified statements from authorized officials of the institutions attended, or submit statutory declarations giving the required information.

3. ENGLISH FACILITY REQUIREMENTS

All applicants are required to submit evidence of facility in English acceptable to the University of Toronto. The following evidence is acceptable:

(a) The University of Michigan English Language Test. This test is available at the University of Toronto for residents of the Toronto area. Enquiries about writing the test in Toronto should be addressed to the Department of Admissions, Simcoe Hall, University of Toronto.

(b) The Certificate of Proficiency in English issued by the Universities of Cambridge or Michigan.

Information about writing the tests in (a) or (b) above in overseas centres may be obtained from the Department of Admissions, Simcoe Hall, University of Toronto.

(c) Standing in English Composition in the Ontario Grade XIII Certificate, or other certificates recognized by the University of Toronto as equivalent.

The University is prepared to consider other evidence of English Facility which may be submitted for evaluation to the Registrar of the University.

4. MATURE STUDENTS

(a) *Admission Regulations*

Candidates of mature age (30 years or older on October 1 of the regular session, or July 1 of the summer session, to which admission is sought) who have lived in Ontario for a minimum period of one year, and are normally resident in Ontario, may request special consideration if they have not completed in full the published Grade XIII (or equivalent) requirements. Such applicants must submit a birth certificate at the time of application.

(b) *Probationary Status*

Candidates accepted by the Senate's Committee on Admissions as mature students are admitted on probation.

Mature students, registered in full-time day courses, must obtain standing in their first year of full-time study in order to have their probationary status removed. If they do not obtain standing they will not be allowed to repeat the year or to enrol in any other course in the University until they present in full the published admission requirements.

5. CANDIDATES FOR FIRST YEAR

(a) *Procedure for Application*

A candidate seeking admission to the First Year must submit to the Department of Admissions, Office of the University Registrar, Simcoe Hall, a completed application form (obtainable at the Registrar's Office) as well as the following documents:

(i) Ontario Grade 13 or an equivalent certificate, indicating the subjects studied and the grades obtained;

(ii) A candidate who has previously attended a university or college for *any* period of time, must submit the following:

(a) Official transcripts issued by the University or College previously attended, giving in detail the courses completed, with the standing and grades in each. Transcripts or a supporting letter from the Registrar of the University or College must indicate that the candidate has been granted honourable dismissal and is not debarred from returning to the institution concerned in the session to which he seeks admission in the University of Toronto.

(b) A calendar of the university giving full descriptions of the courses studied.

Applications for admission *should be submitted as early as possible in the year for which the candidate seeks admission.*

(b) *Terminal Dates for Submission of Applications and Certificates*

1. March 1, 1964—Applications for Provisional Admission (See Section 6)
2. June 1, 1964—All other applications. Only in circumstances which the Committee on Admissions deems exceptional will a late application be considered.
3. Aug. 26, 1964—All certificates which have been issued before this date.
4. Sept. 1, 1964—Certificates issued on or after Aug. 26, 1964.

6. PROVISIONAL ADMISSION ARRANGEMENTS
(Ontario Applicants for First Year)

Well qualified candidates from Ontario Secondary Schools who apply before March 1st will receive Provisional Admission on the basis of the High School records and other information. Such applicants will be told that a place is being reserved for them in the course of their first choice, and they will receive automatic confirmation of this preliminary offer of admission, if they achieve in their Ontario Grade 13 examinations a stated overall average (specified in the letter of provisional admission) and if they meet the subject requirements for the course of their choice.

7. APPLICATION FOR ADMISSION WITH ADVANCED STANDING

A candidate seeking admission on an advanced standing basis must submit to the Department of Admissions, Office of the University Registrar, Simcoe Hall, prior to the dates mentioned above, his completed application form and the documents outlined in 5 (a) (i) and (ii).

8. ADMISSION REGULATIONS CONCERNING CANDIDATES WHO HAVE PREVIOUSLY FAILED IN UNIVERSITY WORK

(a) A candidate who, on one occasion has failed to secure the right to advance to a higher year at the University of Toronto or at any other institution of higher learning, may be eligible for selection to the University of Toronto subject to warning of probable required withdrawal from his Faculty and possible debarment from the University on a second failure.

(b) A student who on two occasions has failed to secure the right to advance to a higher year at the University of Toronto will normally be refused readmission to his faculty and may be debarred from registration in any division of the University of Toronto. Candidates with two such failures at other institutions will normally be refused admission.

9. PROCEDURE FOR REGISTRATION

Detailed instructions concerning Registration and Health Requirements will be mailed to returning and newly admitted students before the beginning of each academic year.

10. HEALTH REQUIREMENTS

Every person admitted to the University as an undergraduate must, at the time of his or her first medical examination by the University Health Service, present satisfactory evidence of successful vaccination within three years prior to the date of the examination, or must be vaccinated by the examining physician.

11. PROCEDURES FOR WITHDRAWALS OR TRANSFERS

A student who wishes to withdraw or to transfer his course or division in the University should consult his College Registrar or Faculty/School Secretary.

12. REGULATIONS OF THE UNIVERSITY CONCERNING PENALTIES FOR UNSATISFACTORY WORK BY STUDENTS

(a) In cases of unsatisfactory work of a very serious nature, a faculty Council may recommend to the Senate Committee on Admissions that a student shall be debarred from the University.

(b) A faculty Council should, except in very exceptional circumstances, refuse to re-admit to that faculty any student who on two occasions fails to secure the right to advance to a higher year in that faculty or a like faculty.

(c) A faculty Council may for unsatisfactory work suspend a student from regular attendance in that faculty for a given period of time not exceeding 2 years and/or until the satisfaction of other conditions as it may see fit. Upon satisfying the conditions of the suspension the student shall be entitled to re-enrolment in that faculty.

(d) Any student who withdraws after February 15, or who does not withdraw but does not write the annual examinations, will be regarded for the purposes of these regulations as having failed his year.

13. APPEALS

A student wishing to appeal to the Senate against a decision of a faculty or school council should consult the secretary of the faculty or school, the registrar of the college, or the office of the university registrar about the preparation and submission of his petition to the Secretary of the Senate.

SPECIAL STUDENTS

Graduates of the University of Toronto and of recognized universities who wish to take one or more undergraduate subjects may be registered as special students in the Faculty of Applied Science and Engineering, subject to the approval of the teaching department concerned. Application must be made to the Secretary of the Faculty.

RESIDENCE ACCOMMODATION

There is a University Men's Residence (Devonshire House) for which men undergraduates are eligible but which can accommodate only a small percentage of them. Early application is advisable. Apply to the Secretary, Men's Residences, Simcoe Hall.

Each of the four Arts Colleges also maintains a Men's Residence into which some engineering students are accepted. Further information may be obtained from:

University College—Dean of Men
Victoria College—Senior Tutor
Trinity College—Registrar, Trinity College
St. Michael's College—The Superior

HOUSING SERVICE

For the convenience of those students who are not able to find accommodation in the University and College residences, the University maintains a listing of rooming houses, flats, apartments and

homes. Information on these rooms may be obtained through the Housing Service office at 581 Spadina Avenue, Toronto 4.

Off-campus housing of this nature is not subject to University regulation. However every effort is taken to make the information on the accommodation as complete as possible and students are encouraged to assist in this effort by reporting on the quality of the accommodation that they have occupied.

CAMPUS CO-OPERATIVE RESIDENCE

The Campus Co-operative Residence, Inc. offers certain housing accommodations for undergraduate and graduate students. Since the University of Toronto has no official connection with the Campus Co-operative Residence, Inc., inquiries about accommodation available through that organization should be addressed directly to:

Campus Co-operative Residence, Inc.,
395 Huron Street,
Toronto 5, Ontario.

CHILDREN OF WAR DEAD EDUCATION ASSISTANCE) ACT

Children of War Dead (Education Assistance) Act provides fees and monthly allowances for children of veterans whose death was attributable to military service. Enquiries should be directed to the nearest District Office of the Department of Veterans Affairs.

SECTION VI. FEES, DEPOSITS AND EXPENSES

FEES

1. A student who desires to enrol in the Faculty of Applied Science and Engineering is required to pay at least the First Term Instalment of fees on or before the opening date of the session, and before he can receive his admit-to-lectures card from the Secretary of the Faculty. The amount of the First Term Instalment of fees or of the Total Fee for the session may be ascertained from the schedule of fees below.

2. The Second Term Instalment of fees, if not already paid, is payable on or before January 15. After this date an additional fee of $3.00 per month or portion thereof (not exceeding $10.00), will be imposed until the whole amount is paid. All fees for the session must have been paid in full before the student can be admitted to the annual examinations.

3. In order to avoid delay in registration at the opening of the session it is recommended that at least the First Term Instalment of fees be forwarded by mail as early as possible in September, together with a form, in duplicate, to be provided by the Secretary of the Faculty and filled out by the student, giving his full name, course, year, etc.

4. University fees are payable at the Office of the Chief Accountant, Simcoe Hall, which will be open for the receipt of fees from 9 a.m. to 5 p.m. daily from September 8 to 22 (Saturday September 19th only 9–12) and from 9 a.m. to 1 p.m. daily except Saturday during the remainder of the session. Cheques in payment of these fees should be made payable to the University of Toronto at par in Toronto.

5. **Each undergraduate enrolled in the Faculty of Applied Science and Engineering must pay annual fees to the Chief Accountant according to the schedule below; the total fee in each case is made up of the academic fee and incidental fees; all incidental fees are payable in the first term.**

Schedule of Fees

Academic Year	*Academic Fee	†Incidental Fees	Total Fee (if paid in one instalment)	First Term Instalment	Second Term Instalment
Men					
I-IV	$650	$63	$713	$388	$328
Women					
I-IV	$650	$35	$685	$360	$328

*The Academic Fee includes the following fees:—
Tuition; Library and Laboratory Supply; one Annual Examination; Laboratory Fee; Physical Education; and Degree.

†These Incidental Fees include the following fees:—
For men—Hart House; Students' Administrative Council; Athletic; Health Service; Engineering Society; Faculty Athletic Association.
For women—Students' Administrative Council; Athletic; Health Service; Engineering Society.

6. A late registration fee of $10.00 will be assessed against any student who registers after the last date for normal registration in his or her faculty or school.

OTHER UNIVERSITY FEES

7. Each student is required to pay to the Chief Accountant at the opening of the session, or as otherwise specified, such of the following fees as may be required of him.

EQUIVALENT CERTIFICATE FEE

8. Each student who has been admitted to the First Year upon a certificate or certificates granted outside the Province of Ontario and covering all or any part of the admission requirements, must pay a fee of $5.00.

ADVANCED STANDING FEE

9. Each student who has been admitted to advanced standing from another university or college, must pay a fee of $10.00.

SPECIAL PHYSICAL EDUCATION FEE

10. Each student who has neglected to complete satisfactorily the course in Physical Education of the First Year must pay an additional fee of $50 at the beginning of the next session in which he is registered. This fee will be refunded if the student satisfactorily completes the required programme in that session.

SPECIAL STUDENTS FEES

11. The fee is $95.00 per subject, payable to the Chief Accountant.

SUMMARY OF STUDENTS' EXPENSES

13. The following approximate statement of expenses will give the student a general idea of the cost of obtaining an education in the Faculty of Applied Science and Engineering in the University of Toronto, exclusive of personal expenses:—

1. Fees, see schedule page 29.
2. Board and Lodging, per week ....$20.00 up
3. Books and instruments, per year ....about $100

SECTION VII. COURSES AND DEGREES

1. At the time of registration in the Faculty, the applicant is required to indicate the graduating course in which he intends to proceed to a degree. There are nine courses in Engineering, from which the selection may be made, viz.,

Civil Engineering (Course 1),
Mining Engineering (Course 2),
Mechanical Engineering (Course 3),
Industrial Engineering (Course 4),
Engineering Science (Course 5), (formerly Engineering Physics)
Chemical Engineering (Course 6),
Electrical Engineering (Course 7),
Metallurgy & Materials Science (Course 8),
Applied Geology (Course 9),
Aerospace Engineering (see page 65).

2. The Degree of Bachelor of Applied Science will be awarded to students who complete one of the above courses.

3. The courses extend over four academic years. A student must pass in the work of each academic year before proceeding to the work of the next. See Sec. IX.

4. If, for any reason, an undergraduate wishes to change his course, he must petition the Faculty Council and obtain its approval. Such petition should be submitted by September 15.

5. Students must conform to all lecture room and laboratory regulations. Reports, briefs, theses, and drawings become the property of the Council to dispose of as it may see fit. Drawings, briefs, and field notes will not be accepted unless they have been made at the time and place provided in the time-table.

6. The curricula of the courses of instruction are given in Sec. VIII.

7. Examinations are conducted as explained in Sec. IX.

8. Students in Civil Engineering, Mining Engineering, Mechanical Engineering, Industrial Engineering, Chemical Engineering, Electrical Engineering, Metallurgy and Materials Science and Applied Geology are required to have practical experience in offices, shops, or field, before their degree is granted. Students are asked to submit certificates of this experience as soon as possible after the completion of each period of work. (See Sec. VIII.)

GRADUATE STUDY AND RESEARCH

Facilities are available in the Departments of the Faculty, for graduates with good records of this University or of another University of comparable standing, for post-graduate study and research leading to

the degrees of Master of Applied Science (M.A.Sc.) and Doctor of Philosophy (Ph.D.). For further information see the Calendar of the School of Graduate Studies. Many graduate students receive financial support for equipment, and salaried appointments as research assistants, through a variety of research grants originating both within and outside the University.

Bursaries and Scholarships for graduate students are available in limited number as shown on page 000. Many part-time demonstratorships are open which permit post-graduate work towards a degree.

DIPLOMA COURSE IN OPERATIONS RESEARCH

A one-year diploma course in Operations Research is offered for those who have obtained a bachelor's degree in engineering, science, or mathematics. The diploma course is designed specifically to meet the needs of people who are presently employed in industry and who aspire to develop special skills in the design, analysis, and control of complex organizational systems.

Inquires regarding the Diploma Course in Operations Research should be directed to the Secretary, Faculty of Applied Science and Engineering.

INTERIM HIGH SCHOOL ASSISTANT'S CERTIFICATE TYPE A

Graduation in Engineering Physics is accepted by the Ontario College of Education as meeting the academic requirements for admission to the course leading to a Type A certificate in Mathematics and Physics.

Graduates in other engineering courses may also be admitted to Type A Certificate courses at the Ontario College of Education if they submit official transcripts which indicate that they have sufficient academic credits.

Graduates in engineering courses who lack sufficient academic credits for admission to Type A courses at the Ontario College of Education may be eligible for admission to the Type B course and later for endorsement of the Type B Certificate in Mathematics and Physics.

Inquiries regarding endorsement of Type B Certificates or admission to Type A Certificate courses should be directed to the Director, Advanced Academic Recommendations, Ontario College of Education.

ASSOCIATIONS OF PROFESSIONAL ENGINEERS

Graduation from the Faculty of Applied Science and Engineering leads to registration as a Professional Engineer in the various Associations of Professional Engineers throughout Canada.

SECTION VIII. CURRICULUM

The courses are designed to give the student a thorough grounding in the fundamentals of engineering, with emphasis on their practical application in the field in which he has chosen to study. In the First Year there is little differentiation between the various courses with the exception of Engineering Science. In the succeeding years, specialization develops to a considerable extent, with provision in the Third and Fourth Years for optional subjects in some of the courses.

The Faculty has excellent laboratory facilities, in which the students do practical experiments and problems related to the lecture subjects. In some graduating courses, laboratory work in the Fourth Year consists of the investigation of some specific problem. In all instances, the student's knowledge of the original literature and primary sources of information is extended, and he is given a very desirable and useful training in methods of research. As part of the laboratory instruction, excursions to places of technical interest are arranged by the staff. These excursions are treated as laboratory periods, with the same requirements as to attendance and reports.

As in the case with other professions, the engineer should be prepared to assume positions of professional and community leadership. Accordingly, the curriculum contains a basic core of humanistic-social studies, including English, Political Science, Economics, Modern History, and Philosophy of Science. It is hoped that this introduction to the humanities will stimulate the student to do further reading and study, thereby increasing his professional effectiveness.

On the following pages of this section, the curriculum for each course is set forth in detail. The time devoted to lectures and practical work is indicated as accurately as possible, but is subject to modification as occasion may require. The programme and regulations regarding the courses of study and examination, contained in this Calendar, hold good for this academic year only, and the Faculty of Applied Science and Engineering does not bind itself to adhere for the whole period of a student's course to the conditions here laid down.

Communications relating to curricula, instruction, and examinations in the Faculty of Applied Science and Engineering should be sent to the Secretary of the Faculty.

For information regarding the courses of study leading to the post-graduate degrees, Master of Applied Science, and Doctor of Philosophy,

see the calendar of the School of Graduate Studies, which gives full particulars.

FIRST YEAR CURRICULUM

The courses in Mechanical Engineering, Industrial Engineering, Chemical Engineering, Electrical Engineering and Metallurgy and Materials Science, designated as Division A have a common First Year and the courses in Civil Engineering, Mining Engineering and Applied Geology have a common First Year differing from that of Division A only in that Surveying is included. The First Year curriculum in Engineering Science is designated as Division C.

A student, on petition to the Council, may be permitted to change his course at the end of the First Year.

FIRST YEAR CURRICULUM

Division A		Division B
Mechanical Engineering		Civil Engineering
Industrial Engineering	AND	Mining Engineering
Chemical Engineering		Applied Geology
Electrical Engineering		
Metallurgy and Materials Science		

First Year Subjects Divisions A & B	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	600, 601	2	3	2	3
Engineering Problems and Drawing	137	–	6	–	6
English	2110	2	–	2	–
Mathematics:					
Calculus, Analytical Geometry and Algebra	2410, 136	3	3	3	3
Descriptive Geometry	135	1	–	1	–
Physics:					
Electricity	700, 2502	2		2	
Mechanics	100, 2502	2	3	2	3
Structure and Properties of Matter	2501, 2502	2		2	
Physical Education	3110	–	2	–	2
Practical Experience	10	–	–	–	–
Surveying (Division B only)	150, 151	1	3	–	–

Division C
Engineering Science

First Year Subjects Division C	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry	602, 601	2	3	2	3
Engineering Problems and Drawing	142	–	6	–	6
English	2110	2	–	2	–
Mathematics:					
Algebra and Geometry	2415	2	–	2	–
Calculus	2416	2	–	2	–
Descriptive Geometry	135	1	–	1	–
Physics:					
Electricity	701	2	–	2	–
Statics	101	2	–	–	–
Properties of Matter; Mechanics and Heat	2511, 2512	3	4	3	4
Physical Education	3110	–	2	–	2

CIVIL ENGINEERING

(Course 1)

The course in Civil Engineering has been so designed as to be broad and comprehensive. It has been designed not only to meet the needs of those who have definitely decided to enter this branch of the profession, but also of those who desire an engineering education of such a basic character as to enable them to enter various other fields of engineering employment.

In addition to instruction in engineering subjects, sufficient time is assigned to economic, legal and administrative studies to qualify the graduate in this course not only to engage in any of the branches of Civil Engineering but also to do administrative or executive work in industrial, commercial, government or other undertakings of an engineering character.

In the final year four options are offered:

A—Structural

B—Surveying

C—Municipal and Sanitary

D—Transportation and Soil Mechanics

Because of the common core of Civil Engineering material in the course, a graduate in any option will not be at a serious disadvantage

when engaged in engineering work that is more closely associated with one of the other options.

Most of the subjects in the Third Year are taken by all students, but, in addition to these common subjects, students proceeding to options A, C, and D in the Fourth Year must take the Group A subjects while those proceeding to option B must take the Group B subjects.

The subjects of instruction are shown in the following tables. In these tables numbers have been assigned to the subjects which refer to a more detailed description of each, e.g., Economics, 2720, page 127.

For FIRST YEAR CURRICULUM—DIVISION B, see page 34.

Second Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits	717, 718	2	$1\frac{1}{2}$	–	–
Applied Physics	721, 722	2	3	–	–
Calculus	2420	2	–	2	–
Dynamics	350	–	–	2	–
Economics	2720	2	–	2	–
Engineering Chemistry	607	2	–	–	–
Engineering Geology	2906, 2907	2	1	1	2
Engineering Thermodynamics	302	–	–	2	–
Engineering Problems and Drawing	138	–	6	–	6
Mechanics of Materials	105, 104	2	–	2	3
Physical Metallurgy	815	–	–	2	–
Practical Astronomy	157	–	–	2	–
Practical Experience	10	–	–	–	–
Surveying	153, 154	2	3	1	3

Each student in Civil Engineering is required to state, not later than June 30 following the completion of his Second Year, the group of subjects he desires to pursue in the Third Year. Permission to take either group of subjects must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Third Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Fluid Mechanics	333, 334	2	–	2	3
Highway Engineering I	185, 195	2	1½	–	–
Engineering Mathematics	141, 139	2	1½	2	3
Municipal Planning, Administration and Transportation	186	–	–	3	–
Practical Experience	10	–	–	–	–
Sanitary Engineering	180	2	–	–	–
Soil Mechanics	191, 195	2	1½	–	–
Survey Camp	158	–	–	–	–
One of					
Modern World History	2330	2	–	2	–
Political Science	2730				
And either of the following groups of subjects:					
Group A (Leading to options 1A, 1C and 1D)					
Mechanics of Materials II	110, 113	2	7½	2	6
Structural Design I	111, 113	2		2	
Structural Theory I	112, 113	–		3	
Group B (Leading to option 1B)					
Geodetic Engineering	160, 161	–	–	2	3
Least Squares	159	–	3	–	–
Photogrammetry I	162, 163	2	3	–	–
Photo Interpretation	164, 165	–	–	2	3
Structural Engineering I	114, 115	2	1½	2	3

Civil Engineering students selecting the Group A subjects are required to state not later than June 30 following the completion of their Third Year the options (one of options 1A, 1C or 1D) they desire to pursue in the Fourth Year. Permission to enter upon an option must be sought from the Council. This may be withheld if the number of students offering, or conditions existing at the time, render it impracticable to give this work.

Civil Engineering students selecting the Group B subjects in their Third Year, must pursue option 1B in their Fourth Year.

Fourth Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Construction Management and Business	130	–	–	2	–
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
And one of the following options:					
Option 1a (Structural)					
Behaviour and Design of Steel Structures	118	2	–	2	–
Hydraulic Engineering	343	–	–	2	3
Mathematical Applications	140	2	–	–	–
Reinforced Concrete I	116	2	–	2	–
Reinforced Concrete II	117	2	–	2	–
Soil Mechanics and Foundations	192, 196	2	–	1	2
Structural Theory II	119	2	–	3	–
Thesis Project, Laboratory and Seminar	20, 120	–	12	–	10
Option 1b (Surveying)					
Adjustment of Observations and Computer Programming	168, 169	–	3	2	3
Photogrammetry II	170, 171	1	3	1	$1\frac{1}{2}$
Astronomy	172, 173	1	3	–	–
Electronics	743, 744	2	$1\frac{1}{2}$	–	–
Engineering and Legal Surveys	174	2	–	1	–
Geodesy	175, 176	1	–	1	3
Hydraulic Engineering	343	–	–	2	3
Structural Engineering II	122, 123	2	$4\frac{1}{2}$	2	3
Survey Camp	167	–	–	–	–
Town and Regional Planning	3540, 3541	1	3	1	3
Thesis	20	–	–	–	1

Fourth Year Subjects Course 1	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 1c (Municipal and Sanitary)					
Air and Water Resources......	181	2	–	3	–
Highway Engineering II.......	187	–	–	2	–
Hydraulic Engineering.........	341, 342	2	$1\frac{1}{2}$	2	3
Mathematical Applications.....	140	2	–	–	–
Municipal Engineering and Planning; Sanitary Chemistry	182	2	–	2	–
Reinforced Concrete I.........	116, 121	2	3	2	3
Soil Mechanics and Foundations................	192, 196	2	–	1	2
Thesis Project, Laboratory and Seminar...............	20, 183	–	$7\frac{1}{2}$	–	7
Option 1d (Transportation and Soil Mechanics)					
Air Photo Interpretation.......	189, 197	1	3	–	–
Highway Engineering II.......	187	–	–	2	–
Hydraulic Engineering.........	343	–	–	2	3
Mathematical Applications.....	140	2	–	–	–
Pleistocene Geology...........	2936	2	–	2	–
Reinforced Concrete I.........	116, 121	2	3	2	3
Soil Mechanics and Foundations	192, 196	2	2	1	–
Transportation Engineering...	188	2	–	1	–
Earth Structures and Foundations................	193	1	–	2	–
Thesis Project, Laboratory and Seminar...............	20, 198	–	4	–	9

MINING ENGINEERING

(Course 2)

The Mining Engineer is concerned with all aspects of the winning of metals and minerals from their geological environments in the earth's crust, and of their conversion to forms in which they can best be utilized in the growing needs and comforts of man. Thus, the course in Mining Engineering has been designed to prepare its graduates for successful participation in the engineering, operational, and administrative activities of those aspects.

The professional fields concerned include mineral exploration, evaluation and development of mineral properties, the mining of ores from a multiplicity of geological situations by the most advanced methods, the treatment of ores in beneficiating and metallurgical plants, and the economics of mineral markets. For the enhancement of abilities in supervision and management, the administrative viewpoint and attitude are stressed in the professional subjects during the later years of the course.

Building upon a foundation in the disciplines of mathematics, physics, and chemistry, the student proceeds through training in geology, mechanics, electricity, economics, business, and general engineering subjects, to a growing proportion of specifics dealing with the fields which the course is designed to serve. The diversification of this training renders the Mining Engineer capable of successful participation in all branches of industry and commerce.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 127.

For FIRST YEAR CURRICULUM—DIVISION B, see page 34.

SECOND YEAR SUBJECTS COURSE 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
A. C. Circuits I	717, 718	2	1½	–	–
Analytical Chemistry Laboratory	606	–	6	–	–
Calculus	2420, 144	2	1½	2	1½
Chemistry	605	2	–	–	–
Economics	2720	2	–	2	–
Historical and Stratigraphic Geology	2930	–	–	2	1
Mechanics of Materials	102, 104	2	–	2	3
Mineralogy and Lithology	2910, 2911	2	2	2	2
Mining	221	1	–	1	2
Oral Expression	271	–	–	–	2
Physical Geology	2900, 2901	2	3	–	–
Practical Experience	10	–	–	–	–
Surveying	155, 156	1	3	2	2

THIRD YEAR SUBJECTS COURSE 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	201, 202	1	3	1	3
Elementary Structural Engineering	124, 125	1	–	2	3
Fluid Flow and Pumping Systems	335, 336	3	3	–	–
Geological Field Work	2983	–	–	–	–
Engineering Thermodynamics	306, 307	1	–	1	3
Metallurgy	804	–	–	1	–
Mineral Dressing	241, 243	2	–	2	6
Mining	222	1	–	2	–
Mining Laboratory	223	–	3	–	2
Operations Research	412, 413	2	1½	–	–
Practical Experience	10	–	–	–	–
Structural Geology	2950, 2951	1	3	1	3
Summer Essays	261	–	2	–	–
Survey Camp	158	–	–	–	–
Wet Analysis	203	–	3	–	3
And one of:					
Modern World History	2330 }	2	–	2	–
Political Science	2730 }				

Fourth Year Subjects Course 2	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	2140	1	–	1	–
Glacial Geology and Ground Water	2934, 2985	1	–	1	–
Machine Design	371, 372	1	–	1	3
Metallurgy	808, 809	1	–	1	3
Mine Operation and Administration	224, 225	2	2	2	6
Mineral Deposits	2960	2	–	2	–
Mine Ventilation	321, 251	2	3	–	–
Mining Geology	2968	–	–	2	–
Ore Dressing	244, 245	1	6	1	–
Physical Metallurgy	815	–	–	2	–
Practical Experience	10	–	–	–	–
Precambrian Geology	2944, 2945	2	1	–	–
Philosophy of Science	2040	2	–	–	–
Thesis Project, Laboratory, and Seminar	20, 275	–	$5\frac{1}{2}$	–	6

MECHANICAL ENGINEERING

(Course 3)

Traditionally associated with the art and science of power generation and the machines and devices by which power is usefully applied and controlled, Mechanical Engineering, like other branches of the engineering profession, participates actively in the advancement of knowledge and interprets this knowledge in the design and development of practical systems.

In manufacturing industry, in the transportation and power utilities, in the high-performance field of air and space engineering, or in engineering aspects of major works and structures, the mechanical engineer finds professional occupation, either as employee or consultant. His responsibility will generally be for the superintendence of operations and personnel, for the design of products and processes, and may include the administration of enterprises.

The curriculum in Mechanical Engineering provides an analytical training in mathematics and the physical sciences designed as a disciplinary basis for active professional practice. Recognition is given, however, to the purer scientific and philosophical concepts essential to postgraduate study and research.

The subjects of instruction are shown in the following tables, in which the assigned Subject Numbers refer to the more detailed descriptions given later, e.g., Economics, 2720, page 127.

For FIRST YEAR CURRICULUM—DIVISION A, see page 34.

Second Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	717, 718	–	–	2	1½
Calculus....................	2420	2	–	2	–
Dynamics of Machines........	357	3	–	3	–
Economics..................	2720	2	–	2	–
Electricity..................	714, 713	2	3	–	–
Engineering Chemistry........	607	2	–	–	–
Heat Engineering, Elementary	303	–	–	2	–
Machine Design..............	356, 358	–	6	2	6
Mathematical Analysis........	383	–	1½	–	1½
Mechanical Engineering.......	355	1	–	–	–
Mechanics of Materials I.....	105, 104	2	3	2	–
Physical Metallurgy..........	817, 818	2	–	2	1½
Practical Experience..........	10	–	–	–	–

Third Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Equations	2432	2	–	2	–
Electronics	743, 744	2	1½	–	–
Electric Machines	747, 748	2	1½	2	3
Engineering Analysis	386	–	1½	–	3
Engineering Thermodynamics	309, 310	2	3	2	3
Fluid Mechanics	333, 334	2	–	2	3
Heat Engineering	308	2	–	1	–
Machine Design	363, 364	2	6	–	3
Practical Experience	10	–	–	–	–
Treatment of Technical Data	387	–	–	2	3
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 3	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Engineering	390	1	3	2	3
Elements of Control Theory	391, 392	1	–	1	3
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Heat Power Engineering	323, 324	2	3	2	4½
Hydraulics	344, 345	2	3	2	4½
Industrial Management	396	1	–	–	–
Internal Combustion	322	–	–	2	–
Machine Design	373, 374	2	3	2	4½
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Structural Engineering	126, 127	2	3	–	–
Thesis	20	–	1	–	1

INDUSTRIAL ENGINEERING

(Course 4)

The modern view of Industrial Engineering is that of a field concerned essentially with the analysis, design, improvement and operation of integrated systems of men, materials and equipment. This new concept crystallized when it became clear that certain modern technical fields, including operations research, control theory, computer science, and probability and statistics, constituted a body of knowledge particularly useful in the operation and management of modern business, industry and government.

As a logical outcome of this development, the course in Industrial Engineering was established in 1958 to provide graduates in engineering specializing in the theory and practice of these subjects. This specialization rests upon a substantial foundation in science and mathematics, in fundamental engineering disciplines including fluid mechanics, applied thermodynamics, electrical science, mechanics of materials and machine design, and in such subjects as economics, organizational structure, financial control and industrial psychology.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 127.

For FIRST YEAR CURRICULUM—DIVISION A, see page 34.

Second Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Alternating-Current Circuits...	717, 718	–	–	2	1½
Calculus....................	2420	2	–	2	–
Dynamics...................	350	–	–	2	–
Economics..................	2720	2	–	2	–
Electricity..................	714, 713	2	3	–	–
Engineering Chemistry........	607	2	–	–	–
Mathematical Analysis........	383	–	1½	–	1½
Mechanical Design............	359, 360	1	6	1	6
Mechanics of Materials.......	102, 104	2	3	2	–
Practical Experience..........	10	–	–	–	–
Probability and Statistics.....	2423, 2424	2	2	2	2
Physical Metallurgy..........	817, 818	2	–	2	1½

Third Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Accounting	2734	2	–	2	–
Differential Equations	2432	2	–	2	–
Electronics	743, 744	2	$1\frac{1}{2}$	–	–
Elementary Structural Engineering	124, 125	1	–	2	3
Engineering Data Processing	3331, 3332	–	–	2	3
Fluid Mechanics	337, 338	2	3	–	–
Engineering Thermodynamics	311, 312	2	3	–	–
Industrial Management	3030, 3031	2	3	2	3
Numerical Analysis	2433, 2434	2	3	2	3
Practical Experience	10	–	–	–	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 4	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Current Developments in Industrial Engineering	409, 410	–	–	2	2
Dynamics of Industrial Systems	405, 406	–	–	2	3
Elementary Control Theory	407, 408	2	3	2	3
Electric Machines	760, 761	2	3	–	–
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Industrial Engineering Seminar	411	–	–	–	2
Industrial Psychology	2840	–	–	2	–
Machine Design	375, 376	2	3	2	3
Operations Research I	401, 402	2	3	2	3
Operations Research II	403, 404	2	3	–	–
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Thesis	20	–	2	–	2

ENGINEERING SCIENCE

(Course 5)

The Course in "Engineering Physics" was established in 1934 "to afford a training in mathematics and physics beyond that which it is possible to give in the other undergraduate courses in engineering". Originally the options offered in the Third and Fouth Years were related to the physical sciences and the name of the course, Engineering Physics, was appropriate.

In 1958 a Chemical Option was added on the same basis, i.e. in Third and Fourth Years.

In the session 1962–63 the scope of the course was broadened to include, more adequately than in the past, options related to the chemical sciences. The name of the course therefore was changed to "Engineering Science" commencing with the class graduating in 1965.

The purpose of the course is not changed. It is designed for those, who, having a definite flair for mathematics and science, anticipate proceeding to post-graduate study and an occupation in the fields of research and development or teaching.

In the Second Year the student may select one of two programmes, differing by about 4 hours per week, which provide slightly greater emphasis either on the physical or the chemical sciences.

The options offered in the Third and Fourth Years cater to a variety of specific interests and prepare the student for post-graduate work in many of the Engineering Departments or in Physics, Biophysics or Applied Mathematics.

Admission to this course is granted only to those students who, having met the general admission requirements set forth on page 22 of this Calendar, obtain an average of 70% on the nine specified papers of Grade XIII, or the equivalent in other school systems.

Promotion to the Second Year of the Engineering Science course is granted only to those students who, in addition to meeting the regular requirements, obtain a weighted average of not less than 66% on the examinations of the First Year. Students who obtain a weighted average of 60% or over in the First Year of this course, and who have met all the regular requirements, will be permitted to proceed to the Second Year of any course in the Faculty, other than Engineering Science, without condition. Permission to repeat the First Year of the course in Engineering Science must be sought by petition to the Council of the Faculty.

The subjects of instruction are shown in the following tables and are more fully described according to subject reference numbers, page 66 to 132.

For FIRST YEAR CURRICULUM—DIVISION C, see page 35.

Students are required to state at the beginning of the Second Year which elective they intend to choose, and at the beginning of the Third Year which option they intend to pursue. Council retains the right to withhold an option if the number of students offering or conditions existing at the time render it impracticable to give the work.

Second Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Differential Calculus	2425	2	–	2	–
Economics	2720	2	–	2	–
Electric Circuits	715, 716	2	1½	2	1½
Integral Calculus	2426	2	–	2	–
Mathematical Problems	2428	–	3	–	3
Physical Chemistry	608, 609	2	1½	2	1½
Physics	2521, 2522	3	3	3	3
Probability and Statistics	2427	2	–	2	–
*And either of the following groups of subjects:**					
Dynamics	351	2	–	–	–
Mechanics of Materials	103, 104	–	–	2	3
or					
Inorganic Chemistry	2621	2	–	2	–
Chemical Engineering Science Laboratory	610	–	–	–	3

*It should be noted that Dynamics and Mechanics of Materials are desirable preliminary subjects for those taking Advanced Mechanics, Mechanics of Solids and Structures, or Applied Elasticity, in the Third Year.

Third Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5a, Aerospace					
Advanced Mechanics	1030	2	–	2	–
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	$1\frac{1}{2}$
Mechanics of Solids and Structures	1034, 1035	2	3	2	3
Fluid Mechanics	1032, 1033	2	3	2	3
Physics of Metals	816	1	–	1	–
Physics Laboratory	2532	–	3	–	3
Thermodynamics and Statistical Physics	2531	2	–	2	–
Theory of Functions	2437	2	–	2	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5c, Chemical					
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	$1\frac{1}{2}$
Atomic and Molecular Structure	2631	2	–	2	–
Chem. Eng. Thermodynamics	640	2	–	2	–
Chem. Eng. Rate Processes	641	3	–	3	–
Fluid Mechanics	1032, 1033	2	3	2	3
Chem. Eng. Problems and Lab.	642	–	9	–	9
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5e, Electrical					
Advanced Mechanics	1030	2	–	2	–
Atomic Structure and Quantum Physics	2533	2	–	2	–
Circuit Analysis	742	2	–	2	–
Differential Equations	2438	2	–	2	–
Electronics	739, 738	2	–	2	3
Physics of Metals	819	–	–	2	–
Physics Laboratory	2532	–	3	–	3
Physics of Solids and Fluids	2534	2	–	–	–
Thermodynamics and Statistical Physics	2531	2	–	2	–
Theory of Functions	2437	2	–	2	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Third Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5g, Geophysics					
Advanced Mechanics	1030	2	–	2	–
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	1½
Mineralogy and Lithology	2910, 2911	2	2	2	2
Physical Geology	2902, 2901	–	3	–	–
Physics Laboratory	2532	–	3	–	3
Physics of Solids and Fluids	2534	1	–	1	–
Physics of the Earth	2536	2	–	2	–
Structural Geology	2950, 2951	1	3	1	3
Thermodynamics and Statistical Physics	2531	2	–	2	–
Theory of Functions	2437	2	–	2	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5m, Materials Science					
Advanced Mechanics	1030	2	–	2	–
Atomic and Molecular Structure	2631	2	–	2	–
Chemistry of Metals	828, 829	1	–	1	4
Differential Equations	2438	2	–	2	–
Metallurgical Thermodynamics	830, 831	1	2	1	2
Physics and Chemistry of Materials	832	2	–	2	–
Physics of Metals	821, 822	2	6	2	3
Physics of Solids and Fluids	2534	1	–	1	–
Theory of Functions	2437	2	–	2	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5n, Nuclear					
Advanced Mechanics	1030	2	–	2	–
Applied Elasticity	365, 366	1	3	1	3
Atomic Structure and Quantum Physics	2533	2	–	2	–
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	1½
Fluid Mechanics	1032, 1033	2	3	2	3
Nuclear Physics	2535	1	–	1	–

Third Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Physics Laboratory	2532	–	3	–	3
Thermodynamics and Statistical Physics	2531	2	–	2	–
Theory of Functions	2437	2	–	2	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5p, Physics					
Advanced Mechanics	1030	2	–	2	–
Applied Elasticity	365, 366	1	3	1	3
Atomic Structure and Quantum Physics	2533	2	–	2	–
Crystallography	2916	1	–	1	–
Differential Equations	2438	2	–	2	–
Electronics	739, 738	2	–	2	3
Physics Laboratory	2532	–	3	–	3
Physics of Solids and Fluids	2534	1	–	1	–
Thermodynamics and Statistical Physics	2531	2	–	2	–
Theory of Functions	2437	2	–	2	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				
Option 5t, Thermodynamics					
Advanced Mechanics	1030	2	–	2	–
Applied Elasticity	365, 366	1	3	1	3
Differential Equations	2438	2	–	2	–
Electronics	740, 741	2	–	2	$1\frac{1}{2}$
Fluid Mechanics	1032, 1033	2	3	2	3
Heat Engineering	313, 314	2	3	2	3
Physics Laboratory	2532	–	3	–	3
Thermodynamics and Statistical Physics	2531	2	–	2	–
Theory of Functions	2437	2	–	2	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 5	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5a, Aerospace					
Aerodynamics	1040, 1041	2	–	2	3
Atomic Physics	2546	3	–	3	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
Engineering Design	1042, 1043	1	3	2	3
English	2140	1	–	1	–
Gasdynamics	1048, 1049	2	1½	1	3
Mechanics of Solids and Structures	1044, 1045	1	3	1	–
Philosophy of Science	2040	2	–	–	–
Plasmadynamics	1046, 1047	1	–	2	1½
Thesis	20	–	–	–	–
Transport Phenomena	1050	1	–	1	–
Option 5c, Chemical					
Chem. Eng. Design	666	2	6	2	6
Chem. Eng. Laboratory	652	–	9	–	–
Chem. Eng. Thermodynamics and Kinetics	665	3	–	3	–
English	2140	1	–	1	–
Instrumental Methods	663	–	–	2	–
Mass Transfer	650	2	–	2	–
Organic Chemistry	660, 661	3	–	–	6
Philosophy of Science	2040	2	–	–	–
Physics of Metals	816	1	–	1	–
Process Dynamics	664	2	–	2	3
Thesis	20	–	–	–	–
Option 5e, Electrical					
Acoustics	790, 791	1	–	1	1½
Communication Systems	770, 771	–	–	3	3
Control Systems	766, 767	2	1½	2	1½
Differential Equations of Mathematical Physics	2445	2	–	2	–
Electric Machines	745, 746	2	1½	2	1½
Electromagnetic Theory, Applied	773	2	–	2	–
Electronic Circuits	768, 769	3	3	–	–
English	2140	1	–	1	–
Microwave Engineering	776, 777	–	–	2	1½
Operational Methods	772	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Thesis	20	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week First Term Lect.	First Term Lab.	Second Term Lect.	Second Term Lab.
Option 5g, Geophysics					
Atomic Physics	2546	3	–	3	
Differential Equations of Mathematical Physics	2445	2	–	2	–
Electromagnetic Theory, Applied	773	2	–	2	–
English	2140	1	–	1	–
Geophysical Methods	2561, 2562	2	6	2	6
Mineral Deposits	2960	2	–	2	–
Petroleum Geology	2964, 2965	2	–	2	3
Philosophy of Science	2040	2	–	–	–
Precambrian Geology	2944, 2945	2	1	–	–
Thesis	20	–	–	–	–
Option 5m, Materials Science					
Atomic Physics	2546	3	–	3	–
Chemistry of Metals (Session 1964–65 only)	828, 829	1	–	1	4
Differential Equations of Mathematical Physics	2445	2	–	2	–
English	2140	1	–	1	–
Philosophy of Science	2040	2	–	–	–
Physics and Chemistry of Materials Laboratory (Session 1964–65 only)	827	–	12	–	9
Physics and Chemistry of Materials Seminar	826	–	3	–	3
Physics of Metals	823, 824	2	3	2	3
X-Ray Crystallography	2918	–	–	2	–
Thesis	20	–	–	–	–
Option 5n, Nuclear					
Differential Equations of Mathematical Physics	2445	2	–	2	–
Control Systems	766, 767	2	$1\frac{1}{2}$	2	$1\frac{1}{2}$
Electromagnetic Theory, Applied	773	2	–	2	–
English	2140	1	–	1	–
Heat Transfer	328	–	–	2	–
Nuclear and High Energy Physics	2544	2	–	2	–
Nuclear Engineering	670, 671	2	3	2	3
Operational Methods	772	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Physical Metallurgy	816	1	–	1	–
Physics Laboratory	2542	–	6	–	3
Thesis	20	–	–	–	–

Fourth Year Subjects Course 5—*Continued*	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Option 5p, Physics					
Electronic Circuits	768, 769	3	3	–	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
Electromagnetic Radiation and Matter	2541	2	–	2	–
Electromagnetic Theory, Applied	773	2	–	2	–
English	2140	1	–	1	–
Molecular Physics and Statistical Mechanics	2543	2	–	2	–
Nuclear and High Energy Physics	2544	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Physics Laboratory	2542	–	6	–	6
Quantum Mechanics	2545	2	–	2	–
Thesis	20	–	–	–	–
Option 5t, Thermodynamics					
Atomic Physics	2546	3	–	3	–
Computational Methods	393	1	3	–	–
Differential Equations of Mathematical Physics	2445	2	–	2	–
English	2140	1	–	1	–
Gasdynamics	1048, 1049	2	$1\frac{1}{2}$	1	3
Heat Engineering Laboratory	329	–	3	–	3
Heat Power Engineering	326	1	–	1	–
Heat Transfer	328	–	–	2	–
Refrigeration and Air Conditioning	325	2	–	–	–
Internal Combustion	327	1	–	1	–
Machine Design	377	–	–	2	–
Operational Methods	772	2	–	2	–
Philosophy of Science	2040	2	–	–	–
Thesis	20	–	–	–	–
Vibration Engineering	798, 799	1	–	1	3

CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

(Course 6)

The chemical engineer is concerned with the development and operation of processes by means of which matter is chemically altered to a more useful form, and in the design, construction, operation and management of plant in which to effect such changes. Apart from such obviously chemical processes as those concerned with the production of acids, alkalis, salts, petroleum, rubber products, pulp and paper, explosives, paints and varnishes, soap, plastics, etc., there are many industrial processes where chemistry plays a part, or where a knowledge of chemistry is valuable. There is thus a wide field of endeavour for the chemical engineer. In order to equip a student to enter this field, the course in chemical engineering is intended to provide the student with training in the principles of the major divisions of chemistry and chemical engineering, together with an understanding of such other engineering subjects as thermodynamics, hydraulics, electricity, mechanics of materials, and machine design.

As part of the work of the Fourth Year each student is assigned a problem involving original investigation, in order to let him apply to some extent what he has learned, and to introduce him to the chemical literature. It also serves as an introduction to research for those who are attracted to it, and who, because of their basic training are equipped to carry on research in chemistry or chemical engineering at the graduate level or in laboratories outside the university.

For those students considering taking up the teaching of science as a profession, the nature and extent of the thesis subject in the Fourth Year may be modified to allow the student to take such other instruction as may be necessary to shorten the time required before becoming professionally qualified.

The subjects of instruction are shown in the following tables. In these tables reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 127.

For FIRST YEAR CURRICULUM—DIVISION A, see page 34.

SECOND YEAR SUBJECTS COURSE 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	615, 614	2	9	–	–
Analytical Chemistry Laboratory	613	–	–	–	–
Calculus	2420, 144	2	1½	2	1½
Chemical Engineering Science Laboratory	619	–	–	–	10½
Economics	2720	2	–	2	–
Electrical Engineering	719, 720	2	3	2	3
Industrial Chemistry	616	2	–	1	–
Inorganic Chemistry	617	1	–	2	–
Mechanics of Materials	102	2	–	2	–
Organic Chemistry	618	1	–	2	–
Physical Chemistry	2622	2	–	2	–
Practical Experience	10	–	–	–	–

THIRD YEAR SUBJECTS COURSE 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics	633	1	1	1	1
Chemical Laboratory	627	–	6	–	6
Chemical Theory A	625	1	–	1	–
Chemical Theory B	626	2	–	2	–
Fluid Mechanics	337, 338	2	3	–	–
Engineering Thermodynamics	315, 316	2	–	–	3
Industrial Chemistry	630	–	–	3	–
Introduction to Mass and Heat Transfer	631	2	–	2	3
Organic Chemistry	628, 629	2	9	2	6
Practical Experience	10	–	–	–	–
Public Speaking	632	–	1	–	1
And one of:					
Modern World History / Political Science	2330 / 2730	2	–	2	–

Fourth Year Subjects Course 6	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics in Chemical Engineering	653	–	3	–	–
Chemical Engineering Thermodynamics and Kinetics	655	2	–	2	–
Chemical Engineering Laboratory	652	–	9	–	–
Chemical Plant Design	651	1	–	–	3
Electrochemistry	2632, 2633	2	$1\frac{1}{2}$	–	–
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Industrial Management	396	1	–	–	–
Machine Design	378, 379	2	–	1	3
Mass Transfer Operations	650	2	–	2	–
Organic Chemistry	654	1	–	1	–
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Thesis	20	–	3	–	18

ELECTRICAL ENGINEERING

(Course 7)

Although electrical engineering, which includes the field of electronics, is concerned with a vast range of electrical phenomena characterized by power in microwatts at one extreme to power in megawatts at the other, and by frequencies in thousands of megacycles per second down to zero, the same fundamental principles underline the whole range. It is the objective of the Electrical Engineering course to lay a sound scientific foundation for any of the particular areas which the student may eventually enter. Since a thorough grounding in the basic sciences is important, a large portion of the curriculum is devoted to such subjects as Mathematics, Mechanics, Chemistry and basic Electricity and Magnetism. Stress is laid on the calculation of circuits and fields, and on the fundamentals of electronics.

The application of electrical laws and phenomena to engineering practice is dealt with in a number of subjects such as Communication Systems, Feedback Control Systems, Power Systems, Microwave Engineering and Electric Machinery. In common with the other engineering courses, subjects in allied fields are included in the curriculum; for example, thermodynamics and physical metallurgy. Also, in recognition of the fact that the successful engineer frequently assumes an administrative or executive position, the curriculum includes some subjects, such as Economics, which serve to broaden the student's viewpoint beyond the strictly technical field.

Because so much fundamental material must be covered in the undergraduate curriculum, specialization is reserved for the post-graduate years when the student may pursue intensive studies in areas such as feedback control systems, energy conversion, high-voltage phenomena, feedback control systems, energy conversion, high-voltage phenomena, microwaves, plasmas, radio astronomy, and bio-medical electronics.

The electrical engineer must treat the phenomena he encounters largely by mathematical analysis. It is important, therefore, that the student possess a natural aptitude for mathematics as well as qualities of imagination and abstract reasoning.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description, e.g. Economics, 2720 page 127.

For FIRST YEAR CURRICULUM—DIVISION A, see page 34.

Second Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Physics	721, 722	–	–	2	3
Chemistry	2623	2	–	–	–
Calculus and Differential Equations	2421	2	2	2	2
Dynamics	352, 353	2	1½	1	1½
Economics	2720	2	–	2	–
Electric Circuits I	710	3	2	3	2
Electric and Magnetic Fields	711	2		2	
Electrical Measurements	712	–	–	2	–
Electrical Laboratory	713	–	3	–	3
Mechanics of Materials	106, 104	2	3	1	–
Practical Experience	10	–	–	–	–

Third Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Applied Mathematics	732	2	2	2	2
Electric Circuits II	733	3	–	3	–
Electric Machinery I	734	2	–	1	–
Electronics	737	2	–	3	–
Electrical Problems	736	–	4	–	4
Electrical Laboratory	735	–	3	–	3
Electronics Laboratory	738	–	–	–	3
Heat Engineering Laboratory	318	–	3	–	–
Machine Design	367, 368	2	3	–	–
Physics of Metal	819, 820	–	–	2	1½
Practical Experience	10	–	–	–	–
Thermodynamics	317	2	–	1	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 7	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Electronic Circuits	768, 769	3	3	–	–
Electric Machinery II	763, 764	3	3	–	–
Computer Logic and Design	781	1	–	1	–
Control Systems	765, 767	2	1½	2	1½
Electromagnetic Engineering	762	2	1	2	1
Engineering Law	3440	1	–	–	–
English	2140	1	–	1	–
Fluid Mechanics	346, 347	1	–	2	3
Industrial Management	396	1	–	–	–
Philosophy of Science	2040	2	–	–	–
Practical Experience	10	–	–	–	–
Thesis	20	–	1	–	1
And one subject from each of Groups A, B, and C.					
Group A					
Communication Systems	770, 771	–	–	3	3
Electric Power Systems	779, 780	–	–	3	3
Group B					
Microwave Engineering	776, 777	–	–	2	1½
Electric Machinery III	774, 775	–	–	2	1½
Group C					
Acoustics	792, 793	–	–	2	1½
Illumination	794, 795	–	–	2	1½

METALLURGY AND MATERIALS SCIENCE

(Course 8)

"Metallurgy and Materials Science" is the study of the production, structure, and properties of the engineering materials used in structures, machines and devices.

Modern technology makes increasingly severe demands upon both metallic and non-metallic solids; in fact, it is difficult to think of an engineering project whose basic limitations do not reside in the materials which are available. For example, aerospace travel requires materials ca-

pable of withstanding extremes of heat, cold and pressure; the utilization of nuclear energy is limited only by materials which can withstand the effects of radiation and high neutron flux, while the transistor and the computer depend upon materials having special electrical and magnetic properties. As industry expands, the metallurgist or materials engineer will be called upon to play an increasingly important role in the economy.

The course is designed to place primary emphasis upon the fundamental principles which underly the chemical, physical and mechanical properties of solids. In the fourth year, each student is assigned an experimental problem involving original work and, where possible, this is related to the acutal research in progress in the department. The student is, therefore, introduced to the methods of research.

The department is equipped with the most modern facilities for the study of the structure of materials, including x-ray diffractions, electron beam microprobe, optical equipment, together with facilities for producing and measuring high temperatures, high vacuum furnaces, etc.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 127.

For FIRST YEAR CURRICULUM—DIVISION A, see page 34.

SECOND YEAR SUBJECTS COURSE 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry	2624	–	3	–	3
Calculus	2420	2	–	2	–
Economics	2720	2	–	2	–
Electrical Engineering	719, 720	2	3	2	3
Inorganic Chemistry	617	1	–	2	–
Materials Processing I	801, 811	1	–	2	3
Mechanics of Materials	105, 104	2	–	2	3
Physical Chemistry	2622	2	–	2	–
Physical Principles of Heat and Optics		2	3	–	–
Probability and Statistics	2423, 2424	2	3	2	3

Third Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry and Physics of Materials	832	2	–	2	–
Chemistry of Metals	802, 803	2	6	2	3
Crystallography	2916	1	–	1	–
Differential Equations	2432	2	–	2	–
Engineering Data Processing	3331, 3332	–	–	2	3
Materials Processing II	833	1	–	1	–
Physics of Metals	821, 822	2	6	2	3
Thermodynamics in Metallurgy	810, 812	2	4	2	4
And one of:					
Modern World History / Political Science	2330	2	–	2	–

Fourth Year Subjects Course 8	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Chemistry of Metals	805, 806	2	3	2	3
Chemistry and Physics of Materials Seminar	826	–	3	–	3
Electrochemistry	2632, 2633	2	$1\frac{1}{2}$	–	–
English	2140	1	–	1	–
Fluid Mechanics (not given session 1964–65)	337	–	–	2	$1\frac{1}{2}$
Heat Transfer	330	2	–	–	–
Philosophy of Science	2040	2	–	–	–
Physics of Metals	823, 824	2	3	2	3
Thermodynamics in Metallurgy	813, 814	2	2	2	2
Thesis	20	–	6	–	9

APPLIED GEOLOGY

(Course 9)

The expanding Canadian economy is making ever growing demands on the Mineral Industry for raw products—iron, copper, uranium, gas, petroleum, etc. Geologists play an important part in this industry. They belong to a team—whose other members are mining engineers and metallurgists—responsible for finding new deposits of metals, mining them, and extracting the metals from the ores. In addition, geologists are widely employed in the petroleum industry.

The course in Applied Geology provides a training in the fundamentals of the geological sciences and graduates in this course are suitably trained to enter the ranks of professional geologists. Students also take work with related departments, such as Mining Engineering, Metallurgy and Materials Science, Chemical Engineering and Civil Engineering, and in this way have some knowledge of other fields of engineering.

The geological subjects are selected so that they will carry the student through from an introductory course to a stage where he has a useful knowledge of the broad field of the subject. He is properly trained to find employment in mining geology, petroleum geology, or engineering geology. Such work may be with exploration companies, oil companies or mining companies.

Graduates in Applied Geology who wish further specialized training in geology may proceed to the M.A.Sc. or Ph.D. degrees, and thus qualify themselves for employment with government geological surveys or as university teachers.

The subjects of instruction are shown in the following tables. In these tables, reference numbers have been assigned to the subjects referring to a more detailed description of each, e.g., Economics, 2720, page 127.

For FIRST YEAR CURRICULUM—DIVISION B, see page 34.

Second Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Analytical Chemistry Laboratory	606	–	6	–	–
Calculus	2420, 144	2	1½	2	1½
Chemistry	605	2	–	–	–
Economics	2720	2	–	2	–
Historical and Stratigraphical Geology	2930, 2931	–	–	2	3
Mechanics of Materials	102, 104	2	–	2	3
Mineralogy and Lithology	2910, 2911	2	2	2	2
Mining	221	1	–	1	2
Optics	723, 724	1	3	1	3
Oral Expression	271	–	–	–	2
Physical Geology	2900, 2901	2	3	–	–
Practical Experience	10	–	–	–	–
Surveying	155, 156	1	3	2	2

Third Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
Assaying	201, 202	1	3	1	3
Descriptive Mineralogy	2913	–	2	–	2
Elementary Geochemistry	2924	2	–	2	–
Geological Field Work	2983	–	–	–	–
Metallurgy	804	–	–	1	–
Mineral Dressing	246	2	–	–	–
Mining	222	1	–	2	–
Ore Microscopy	2915	–	–	–	3
Palaeontology	2938, 2939	2	2	2	2
Petrology	2920, 2921	3	2	2	2
Practical Experience	10	–	–	–	–
Stratigraphy and Sedimentation	2932, 2981	2	2	–	–
Structural Geology	2950, 2951	1	3	1	3
Survey Camp	158	–	–	–	–
And one of:					
Modern World History	2330	2	–	2	–
Political Science	2730				

Fourth Year Subjects Course 9	Subject No.	Hours per week			
		First Term		Second Term	
		Lect.	Lab.	Lect.	Lab.
English	2140	1	–	1	–
Geology of Canada	2904	1	–	1	–
Geological Field Trips	2985, 2987	–	–	–	–
Geophysics	2568, 2569	1	3	1	3
Metallurgy	808	1	–	1	–
Mineral Deposits	2960, 2961	2	–	2	3
Mine Operation and Administration	224, 226	2	–	2	3
Mining Geology	2968, 2969	–	3	2	–
Petroleum Geology	2964, 2965	2	–	2	3
Pleistocene Geology	2936	2	–	2	–
Practical Experience	10	–	–	–	–
Precambrian Geology	2944, 2945	2	3	–	3
Philosophy of Science	2040	2	–	–	–
Thesis	20	–	6	–	–

AEROSPACE SCIENCE AND ENGINEERING

A five year program of study is offered to prepare the student for a career in the aerospace field. It includes the following elements; (a) an introduction to the fundamentals of mathematics, physics, and chemistry, (b) an introduction to aerodynamics, instrumentation, propulsion, structures and design, and (c) an advanced treatment of the subjects required for modern design and research in aerospace science and engineering such as hypersonic aerodynamics, flight dynamics, and space propulsion. Under (a) and (b) the student's training is necessarily broad and basic. The more advanced knowledge needed for the research, development, and design relevant to new aircraft and spacecraft is provided under (c) and is of particular significance. Parts (a) and (b) are provided in a four-year undergraduate course, but the final intensive training under (c) is left for a postgraduate (fifth) year.

The program of study that leads to status as a well-qualified aerospace engineer has been established in two parts as follows:

(i) *Undergraduate Course.* The student registers in the course in Engineering Science, subject to the entrance requirements given on page 22 of this Calendar. This course provides the requisite training in the

fundamental sciences (see (*a*) above). The advanced subjects contained in the Aerospace option given in the third and fourth years are taught by the staff of the Institute for Aerospace Studies (see (*b*) above). The student will receive the degree of Bachelor of Applied Science upon completion of this part of the program.

(ii). *Graduate Course.* The student will then continue his five year program (see (*c*) above) in the Institute for Aerospace Studies, as a candidate for the degree of Master of Applied Science. Details regarding entrance regulations and courses of study are given in the Calendar of the School of Graduate Studies. The facilities of the Institute are available to the student. For details of research projects, assistantships, scholarships and demonstratorships, students should consult the Annual Bulletin of the Institute.

It should be noted that a student who has graduated in another branch of engineering and who desires to qualify as an aerospace engineer may proceed directly with (ii) above, but in this case the course leading to the M.A.Sc. degree must be arranged so that deficiencies in his undergraduate training are made up.

The facilities of the Institute are available for further graduate study leading to the Ph.D. Degree.

OUTLINE OF LECTURE AND LABORATORY SUBJECTS

On the pages that follow a brief description is given of the lectures and laboratory subjects prescribed in the preceding tables of curriculum. The numbers before the subjects are the reference numbers assigned in the tables. For example, 135, Descriptive Geometry, means the course of lecures indicated by this number in the table of curriculum for the First Year on page 34.

Where laboratory reports are to be written outside of assigned laboratory hours the maximum number of such reports is indicated in the description of the laboratory course concerned.

FACULTY REQUIREMENTS

10. Practical Experience.

Students in the courses listed below are required to have, before graduation, practical work of a nature acceptable to the department concerned. This may be obtained during the summer vacations but work done before entering the Faculty may also meet the requirements. Instructions will be issued by the departments concerning the type of work which is acceptable. Practical experience certificate forms may be obtained from the departments and should be returned there when completed.

Course 1	600 hours
Course 2	800 hours
Course 3	600 hours
Course 4	600 hours
Course 6	600 hours
Course 7	600 hours
Course 8	600 hours
Course 9	6 months

20. Thesis

All courses, IV Year.

Every student in the Fourth Year is required to prepare a thesis on an approved subject. Instructions will be issued by the departments concerned.

In some cases written presentation is required, in others oral and written, or it may consist of a research problem followed by a written thesis or report.

DEPARTMENT OF CIVIL ENGINEERING

100. Applied Mechanics. C. F. Morrison, M. W. Huggins, A. C. Davidson, E. Robinsky, S. M. Uzumeri, B. Goodal, G. Heinke, K. Meipoom, R. G. Tress, G. T. Will.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

This subject is divided into two parts, statics and dynamics.

Statics: The principles of statics are discussed, and applied to the composition and resolution of forces. A variety of applications are studied, including plane pin-jointed frames and simple three-dimensional structures.

Dynamics: Theoretical principles and practical applications are discussed for:

Particle motion on straight and curved paths; work energy and power; impulse and momentum; plane translation and rotation of rigid bodies.

Text book: Engineering Mechanics—Higdon and Stiles (Second Edition).

101. Statics. R. A. Collins, J. Schwaighofer.

Course 5, I Year; 2 hrs. lectures per week, first term.

Translational and rotational resultants and equilibrants are discussed together with equivalent force systems in two and three-dimensional space. Emphasis is placed on systems in equilibrium. A variety of applications is studied including frameworks, simple machines, and bending moments and shearing forces in beams.

Text book: Mechanics for Engineers: Statics—Beer & Johnston (Second Edition).

102. Mechanics of Materials. K. Meipoom, R. G. Tress, G. T. Will.

Courses 2, 4, 6 and 9, II Year; 2 hrs. lectures per week, both terms.

In this subject, the fundamental theories of stress and strain are discussed and applied in the design of tension members, riveted joints, pressure vessels, beams, columns, shafts, etc. A number of problems are worked out both in the lecture course and in the drafting room.

Text book: Mechanics of Materials—Higdon, Ohlsen and Stiles.

103. Mechanics of Materials. R. A. Collins.

Course 5, II Year (elective); 2 hrs. lectures per week, second term.

Basic relationships between force, stress, strain, and deflection of bodies made of various engineering materials are discussed. Beams, columns, shafts, tension members and pressure vessels are analysed and designed for strength and stiffness.

Text book: Mechanics of Materials—Popov.

104. Mechanics of Materials Laboratory: General. K. Meipoom, C. E. Helwig, C. W. Dillane, J. D. Barber, R. G. Tress.

Courses 1, 2, and 9, II Year; 3 hrs. laboratory per week, second term.

Course 5, II Year (elective); 3 hrs. laboratory per week, second term.

Courses 3, 4, 7 and 8, II Year; 3 hrs. laboratory per week, first term.

An introduction to testing machines, strain and other measuring devices and standard specifications.

The experimental study of some engineering materials and structural members under applied load.

No laboratory report shall be written outside the assigned teaching hours.

105. Mechanics of Materials. J. D. Barber, S. M. Uzumeri.

Courses 1, 3, and 8, II Years; 2 hrs. lectures per week, both terms.

An introduction to the elastic and inelastic behaviour of solids under various external loading conditions. Strains, stresses and deformations are determined for members subjected to tension, compression, torsion and bending and for pressure vessels by using basic strength of materials theories.

Text: Mechanics of Materials—Popov.

106. Mechanics of Materials. A. C. Davidson.

Course 7, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The fundamental relations among stress, strain and applied load are worked out for tension, compression, twisting and bending in the elastic and inelastic ranges, for various engineering materials. Buckling phenomena are examined for struts and columns. Numerical applications are done in lectures; and problems are assigned for study.

Text: Mechanics of Materials—Popov.

110. Mechanics of Materials II. C. Helwig, J. Schwaighofer.

Course 1, Group A, III Year; 2 hrs. lectures per week, both terms.

Cement and congrete technology; an introduction to the design of reinforced concrete members; behaviour of metals; special topics on bending of beams; failure theories; introduction to experimental stress analysis. Problems and laboratory under Course 113.

Text books: Reinforced Concrete Fundamentals—Ferguson; Concrete Manual by U.S. Bureau of Reclamation. Mechanics of Materials—Popov.

Reference book: Concrete Technology I & II—D. R. Orchard.

111. Structural Design. M. W. Huggins.

Course 1, Group A, III Year; 2 hrs. lectures per week, both terms.

An elementary study of the stress analysis and design of structures, structural members, and their details.

The work covered includes steel and timber tension members, compression members and flexural members, including box girders and plate girders and continuous as well as simple span beams. Welding, riveting and high tension bolting, as methods of connecting structural members, are studied. Design and analysis problems under Course 113.

Text book: Design of Steel Structures—Gaylord and Gaylord.

Reference book: Structural Problems—Young and Morrison.

112. Structural Theory I. C. F. Morrison.

Course 1, Group A, III Year; 3 hrs. lectures per week, second term.

The stress analysis of simple span, continuous and cantilever trusses. Influence lines and index stresses. Truss deflections by analytical and graphical methods. Analysis of statically indeterminate trusses, beams and frames by various methods.

Problems under Course 113.

Text book: Structural Theory—Sutherland and Bowman.

113. Structural Laboratory. Staff in Civil Engineering.

Course 1, Group A, III Year; 7½ hrs. per week, first term, 6 hours per week, second term.

Problems and laboratory to complement subjects 110, 111, and 112. 3 hours per week of the above time in the first term will be devoted to the Cements and Concrete laboratory; the balance will be on problems.

114. Structural Engineering I. G. T. Will.

Course 1, Group B, III Year; 2 hrs. lectures per week, both terms.

An introduction to the analysis and design of structures, structural members and their details.

The work covered includes steel and timber columns, tension members and connections.

Problems under Course 115.

Text books: Design of Steel Structures—Gaylord & Gaylord. C.I.S.C. Steel Construction Series—Book Two. National Building Code of Canada.

Reference book: Elementary Structural Analysis—Norris and Wilbur.

115. Structural Laboratory. G. T. Will.

Course 1, Group B, III Year; 3 hrs. alternate weeks in first term, and 3 hrs. per week, second term.

Design and analysis problems to complement subject 114.

116. Reinforced Concrete I. S. M. Uzumeri.

Courses 1A, 1C & 1D, IV Year; 2 hrs. per week, both terms.

The analysis and design of reinforced concrete beams, columns, slabs, footings and retaining walls.

Problems under Course 120 for Course 1A. Problems under Course 121 for Courses 1C and 1D.

Text book: Reinforced Concrete Fundamentals—Ferguson.

Reference books: Theory & Practice of Reinforced Concrete—Dunham. Reinforced Concrete Design—Sutherland and Reese.

117. Reinforced Concrete II. M. W. Huggins.

Course 1A, IV Year; 2 hrs. per week, both terms.

Ultimate design; prestressed concrete; composite design; design of building frames, arches and bridges. Behaviour of reinforced concrete members.

Problems under Course 120.

Text book: Reinforced Concrete Fundamentals—Ferguson.

Reference books: Theory & Practice of Reinforced Concrete—Dunham. Reinforced Concrete Design—Sutherland and Reese.

118. Behaviour and Design of Steel Structures. D. J. L. Kennedy.

Course 1A, IV Year; 2 hrs. per week, both terms.

A continuation of Course 111. The behaviour of structural elements and structures is discussed and related to design methods and criteria. Topics include, repeated loading, brittle fracture, welding, connections, buckling, inelastic behaviour, analysis and design of metal structures by ultimate load procedures.

Problems under Course 120.

Text books: Plastic Design of Steel Structures—Beedle. C.I.S.C. Steel Construction Series, Books 1, 2, 3.

119. Structural Theory II. G. Kani, R. A. Collins.

Course 1A, IV Year; 2 hrs. per week, first term, 3 hrs. per week, second term.

Analysis of statically indeterminate structures; influence lines for statically indeterminate structures; the use of strain energy,

slope deflection, moment distribution, column analogy and Kani methods; an introduction to plates and shells.

Problems under Course 120.

120. Thesis Project, Laboratory and Seminar. Staff in Civil Engineering.

Course 1A, IV Year; 12 hrs. per week, first term and 10 hrs. per week, second term.

Project, problems and Mechanics of Materials laboratory to supplement courses 116, 117, 118, 119 and 140.

121. Structural Laboratory. Staff in Civil Engineering.

Courses 1C and 1D, IV Year; 3 hrs. per week, both terms.

Design and analysis problems, and testing laboratory to supplement course 116.

122. Structural Engineering II. C. Helwig.

Course 1B, IV Year; 2 hrs. per week, both terms.

Cements and concrete; design and analysis of reinforced concrete members; design of steel structures as an extension to course 114. Problems and concrete laboratory under course 123.

Text books: Reinforced Concrete Fundamentals—Ferguson. Design of Steel Structures—Gaylord & Gaylord.

123. Structural Laboratory.

Course 1B, IV Year; 4½ hrs. per week, first term and 3 hrs. per week, second term.

Design and analysis problems to supplement course 122. In the first term 3 hours per week will be devoted to Cements and Concrete laboratory.

124. Elementary Structural Engineering. A. C. Davidson.

Courses 2 and 4, III Year; 1 hr. lecture per week first term; 2 hrs. lectures per week, second term.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject No. 125).

Text books: Design of Steel Structures—Gaylord & Gaylord. Material Specifications Book One, Properties of Sections Book Two, Steel for Building, Book Three, Canadian Institute of Steel Construction, Toronto. National Building Code of Canada—National Research Council, Ottawa. Basic Reinforced Concrete Design—Large.

125. Structural Engineering Problems. A. C. Davidson.

Courses 2 and 4, III Year; 3 hrs. per week, second term.

Problems supplementing the work covered in lecture course 124 are assigned and worked out in the drafting room.

126. Structural Engineering. J. D. Barber.

Course 3, IV Year; 2 hrs. lectures per week, first term.

The fundamental principles of Statics and Mechanics of Materials are applied to the design and analysis of structural members and their connections. Problems are worked in class and in the drafting room (Subject 127).

Moving loads on simply supported beams; tension, compression and flexural member details.

Text book: Design of Steel Structures—Gaylord & Gaylord.

127. Structural Engineering Problems. J. D. Barber.

Course 3, IV Year; 3 hrs. per week, first term.

Problems supplementing the work covered in lecture course 126.

130. Construction Management and Business. M. G. Tallon, S. G. Hennessey.

Course 1, IV Year; 2 hrs. lectures per week, second term.

A study of heavy and building construction, including job planning and organization, construction methods and equipment, superintendence, job records, labour relations and safety procedures. Elements of business organization and management with an introduction to the principles of control through accounting records and financial statements.

135. Descriptive Geometry. C. A. Wrenshall, H. R. Frizzle.

All courses, 1 Year; 1 hr. lecture per week, both terms.

These lectures deal with the principles of orthographic, oblique and perspective projection and their use in solving problems of straight lines, planes, and curved surfaces.

Text book: Descriptive Geometry—Watts and Rule.

136. Mathematical Problems.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 3 hrs. per week, both terms.

Problems supplementing the work covered in lecture course 2410.

137. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 6 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry and applied mechanics. An introduction to graphical methods of solving engineering problems, e.g., nomography, empirical equations, graphical algebra and calculus, projective geometry. Plotting of original surveys for courses 1, 2 and 9.

Text book: Engineering Drawing—French and Vierck, 9th edition.

138. Engineering Problems and Drawing. C. A. Wrenshall.

Course 1, II Year; 6 hrs. per week, both terms.

Problems in descriptive and projective geometry, nomography,

graphical calculus. Graphs and empirical equations. Structural drawing. Plotting of original surveys. Problems in mathematics.

Text book: Engineering Drawing—French and Vierck, 9th edition.

139. Engineering Mathematics Problems. G. T. Will.

Course 1, III Year; 3 hrs. per week, alternate weeks first term, 3 hrs. per week, second term.

Problems based on the content of Lecture Course 141.

140. Mathematical Applications. R. A. Collins.

Courses 1A, 1C, 1D, IV Year; 2 hrs. lecture per week, first term.

The formulation, discussion and solution of certain civil engineering problems by numerical methods, relaxation techniques, electronic computation, and other approximations.

141. Engineering Mathematics. G. T. Will.

Course 1, III Year; 2 hrs. lectures per week both terms.

Differential equations; series and theory of functions as applied to Civil Engineering.

142. Engineering Problems and Drawing. C. A. Wrenshall, H. R. Frizzle.

Course 5, I Year; 6 hrs. per week, both terms.

Drawing and lettering. Problems in descriptive geometry and applied mechanics. Problems in mathematics (algebra and geometry, and calculus).

Text book: Engineering Drawing—French and Vierck, 9th edition.

143. Engineering Problems and Drawing. C. A. Wrenshall.

Course 8, II Year; 3 hrs. per week, both terms.

Problems in descriptive geometry and mathematics. Graphs and empirical equations.

Text book: Engineering Drawing—French and Vierck, 9th edition.

144. Mathematics Problems. C. A. Wrenshall.

Courses 2, 6 and 9, II Year; 3 hrs. per week, alternate weeks, both terms.

Problems in mathematics.

150. Surveying. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 1, 2 and 9, I Year; 1 hr. lecture per week, first term.

General principles and practice of surveying with the tape, the transit, and the level, and computation of corrections, azimuths, bearings, latitudes and departures, co-ordinates and areas.

Text book: Surveying—Philip Kissam.

Reference books: Plane Surveying—Tracy. Elementary Surveying—Breed and Hosmer. Surveying—Breed.

151. Surveying Field Work. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Courses 1, 2 and 9, I Year; 3 hrs. per week, first term.

Practice in chaining; keeping of field notes; the use of the transit in surveying closed figures and traverse lines; plotting by co-ordinates; computing areas; instrumental work with the level and calculating and volume of excavations.

153. Surveying. O. J. Marshall. B. J. Haynes.

Course 1, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Simple, reverse, compound and spiral curves as applied to Highway and Railroad surveying. Main features of mine and hydrographic surveying. Construction surveying dealing with cross sectioning, earthwork, quantities, mass or haul diagram, super elevation, vertical curves, and layout of roads and sewers.

Text book: Route Surveys—Skelton.

154. Surveying Laboratory. O. J. Marshall, B. J. Haynes, S. G. Bird.

Course 1, II Year; 3 hrs. per week, both terms.

First Term: Field problems, in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy, and earth work quantities.

155. Surveying. H. L. Macklin.

Courses 2 and 9, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Mine surveying, with problems related thereto. Simple curves, stadia and plane table topographical surveying. Practical determination of time, latitude and azimuth by methods adapted to the surveyor's transit.

Text book: Surveying for Civil Engineers—Kissam.

156. Surveying Laboratory. H. L. Macklin, S. G. Bird.

Courses 2 and 9, II Year; 3 hrs. per week, first term; 2 hrs. per week, second term.

First term: Field problems in levelling, traversing, curves and topography.

Second term: Surveying computations, including traversing, curves, astronomy, and mine surveying problems.

157. Practical Astronomy. H. L. Macklin.

Course 1, II Year; 2 hrs. lectures per week, second term.

The derivation of formulae and their application to the solution of spherical triangles and practical problems. Practical determination of time, latitude and azimuth by methods adapted to the use of the surveyor's transit. The subject will be designed to enable the student to carry out these observations at the Summer Survey Camp.

Text book: Practical Astronomy—Nassau.

158. Survey Camp. O. J. Marshall, H. L. Macklin, B. J. Haynes, S. G. Bird.

Course 1, III Year; Aug. 17 to Sept. 18—Dorset or Gull Lake; Courses 2 and 9, III Year; Aug. 26 to Sept. 20—Gull Lake.

Course 1:

(a) Secondary Triangulation and Base Line Measurements.

(b) Highway and Railway Location.

(c) Cross Sectioning and Computation of Earthwork.

(d) Stadia and Plane Table Topography.

(e) Observations for Time, Azimuth, and Latitude.

Courses 2 and 9:

(a) Stadia and Plane Table Topography.

(b) Mine Surveying, using overhead stations.

(c) Shaft plumbing and use of Auxiliary Telescope.

Students in Courses 1, 2 and 9 will be required to take the Survey Camp between the Second and Third Years; on failure to do so, this subject will be carried as a supplemental in the Third Year.

Application to defer attendance at the Camp must be made to the Secretary of the Faculty before July 15th.

159. Least Squares. H. L. Macklin.

Course 1B, III Year; 3 hrs. laboratory per week, first term.

The general principles of probability of errors, elementary problems illustrating the application of Least Squares to the adjustment of observations, empirical constants and formulae.

No laboratory reports shall be written outside the assigned teaching hours.

Text book: Least Squares in Engineering—Marshall and Macklin.

160. Geodetic Engineering. O. J. Marshall.

Course 1B, III Year; 2 hrs. lectures per week, second term.

Principles, equipment and methods of geodetic survey involving triangulation, traverse and levelling of high precision; elementary geodesy and map projections.

161. Geodetic Engineering Laboratory. O. J. Marshall, B. J. Haynes.

Course 1B, III Year; 3 hrs. per week, second term.

Problems and computations supplementing the work covered in subject 160.

162. Photogrammetry I. J. Vlcek.

Course 1B, III Year; 2 hrs. lectures per week, first term.

Outline of photogrammetry. Central projection. Camera: interior orientation. Stereoscopic vision and methods of viewing stereo. Terrestrial photogrammetry: geometry of stereo-pairs, stereocomparator, error analysis. Aerial photogrammetry: camera and film, photography, geometry of single picture, radial line

triangulation, geometry of stereo-pairs, analysis of model deformations and parallax corrections in near vertical pictures. Simple instruments for detail transfer from photo to map.

163. Photogrammetry I. Laboratory. J. Vlcek.
Course 1B, III Year; 3 hrs. per week, first term.
Laboratory work supplementing the lecture course 162.

164. Photo Interpretation. J. Vlcek, D. J. Gerrard.
Course 1B, III Year; 2 hrs. lectures per week, second term.
The use of aerial photographs in geology, land use, forestry, etc.; methods of extracting, and displaying the information available—all based on the use of a large collection of diversified photography.

165. Photo Interpretation Laboratory. J. Vlcek, D. J. Gerrard.
Course 1B, III Year; 3 hrs. per week, second term.
Laboratory work supplementing the lecture course 164.

167. Survey Camp. O. J. Marshall, B. J. Haynes.
Course 1B, IV Year; Aug. 24 to Sept. 18, Gull Lake.
Triangulation, electronic distance measurements, traverses, levelling and astronomical observations by precise methods.

168. Adjustment of Observations and Computer Programming. H. L. Macklin.
Course 1B, IV Year; 2 hrs. lecture per week, second term.
Probability and the theory of accidental errors. Least Squares and its application in the adjustment of surveys. Digital computer programming and applications in survey calculations involving closed figures, area calculations and quantity computations.

169. Adjustment of Observations and Computer Programming. H. L. Macklin.
Course 1B, IV Year; 3 hrs. laboratory per week, both terms.
Problems illustrating the application of least squares to the adjustment of observed data, with particular reference to surveying measurements. Computing experience with desk calculator and digital computer solving surveying problems involving closed traverses, area and quantity computations.

170. Photogrammetry II. J. Vlcek.
Course 1B, IV Year; 1 hr. lecture per week, both terms.
Review of elementary matrix theory. Theory of model restitution. Plotting instruments. Methods of instrumental aerial triangulation and its adjustments. Introduction to analytical methods of aerial triangulation.

171. Photogrammetry II. Laboratory.
Course 1B, IV Year; 3 hrs. laboratory per week, first term; 3 hrs laboratory, alternate weeks, second term.
A laboratory course supplementing subject No. 170.

172. Astronomy. H. L. Macklin.
Course 1B, IV Year; 1 hr. lecture per week, first term.
Precise determination of time, latitude, longitude and azimuth as applied to geodetic surveys.

173. Astronomy Laboratory. H. L. Macklin.
Course 1B, IV Year; 3 hrs. laboratory per week, first term.
Observations and problems to accompany subject 172.

174. Engineering and Legal Surveys. B. J. Haynes.
Course 1B, IV Year; 2 hrs. lecture per week, first term, and 1 hr. lecture per week, second term.
Construction surveying problems dealing with prismoidal volumes and corrections, hydrographic surveying, tunnel surveying, circular curve intersections, area computations, chronological order of land subdivision and layout from early township patterns to present day subdivisions, the weighing of survey evidence in the retracement of construction and legal surveys, and the preparation of legal surveys.

175. Geodesy. O. J. Marshall.
Course 1B, IV Year; 1 hr. lecture per week, both terms.
Geometry of the spheroid, geographic co-ordinates, common map projections with related co-ordinate systems.

176. Geodesy Laboratory. O. J. Marshall.
Course 1B, IV Year; 3 hrs. laboratory per week, second term.
Problems in geodetic computations.

180. Sanitary Engineering. A. P. Bernhart.
Course 1, III Year; 2 hrs. lectures per week, first term.
The objective of Sanitary Engineering and Pollution Control. Basic outline of problems of urbanization and the natural cycle of water. Water Purification. Treatment of domestic and industrial waste waters. Municipal Services—water mains, sanitary sewers, storm water drainage, garbage disposal. Air Pollution Control—equipment and planning considerations.

181. Air and Water Resources. A. P. Bernhart.
Course 1C, IV Year;
2 hrs. lectures per week, first term.
3 hrs. lectures per week, second term.
Water Resources: Natural cycle of water. Pollution by urban developments. Self-purification of natural water bodies. Watershed planning.
Water Purification: Screens, coagulation, sedimentation, filtration, chlorination, fluoridation, softening, iron removal, pumps.
Waste Water Treatment: Screens, grit removal, sedimentation, activated sludge process, trickling filters, chlorination, tertiary treatment, sludge digestion and dewatering. Industrial waste waters.

Air Resources: Natural air movements, micro climates. Causes, effects, history and disasters of air pollution. Aerosols and gaseous pollutants. Control by planning and cleanliness. Dust collectors, gas washers and absorbers, electro-static precipitators.

Pollution Control: As one problem of urbanization, the engineer's responsibility toward the society.

182. Municipal Engineering and Planning; Sanitary Chemistry. A. P. Bernhart, G. W. Heinke.

Course 1C, IV Year, 2 hrs. lectures per week both terms.

Planning: Units of urban planning and their layout; aspects and implementation of planning.

Roads: Layout of systems, cross sections, construction.

Water Supply: Long distance transmission, distribution.

Sanitary and storm sewers: Systems, pumping stations, drainage.

Complete service systems for urban areas: design, administration and financing.

Analysis of Water Pollutants: Physical, chemical, biological. (Oxygen, nitrogen, carbon and iron; turbidity, hardness; micro-organisms.)

183. Thesis Project, Laboratory and Seminar. A. P. Bernhart, R. A. Collins, M. M. Davis, G. W. Heinke.

Course 1C, IV Year; 7½ hrs. per week, first term, 7 hrs. per week, second term.

Thesis project and design problems supplementing courses 140, 181, 182, 187.

Several inspection field trips and reports on Water and Waste-water Plants, Subdivision Construction, Airpollution Control Installations.

Laboratory work on standard testing methods for air and water pollution.

185. Highway Engineering. M. M. Davis.

Course 1, III Year; 2 hrs. lectures per week, first term.

Organization, administration, economics and planning of rural highways; highway materials and paving; principles of location, design, construction and maintenance.

Text book: Highway Engineering—Oglesby and Hewes, 2nd Edition.

Reference Books: The Highway Improvement Act—Ontario Highway Standards and Specifications—Department of Highways of Ontario. Soil Mechanics for Road Engineers—D.S.I.R.—H. M. Printer, Policy on Geometric Design of Rural Highways—A.A.S.H.O.

186. Municipal Planning, Administration and Transportation. H. L. Macklin, M. Hugo-Brunt, M. M. Davis.

Course 1, III Year; 3 hrs. lectures per week, second term.

Contemporary concepts in town and regional planning and their

theoretical, practical and legal applications as applied in Canada.

Organization of municipal government, municipal finance, legislation governing municipal operation, role of the municipal engineer and private practitioner in public works, provisions of municipal services.

Urban and regional growth as affected by transportation, trends, demands, characteristics and capacities, co-ordination with land use and integration with other services.

187. Highway Engineering II. R. M. Soberman.

Course 1C, D, IV Year; 2 hrs. lecture per week, second term.

Elementary traffic characteristics, traffic control, control devices, geometric design, and project evaluation.

Text book: Traffic Engineering—Matson, Smith & Hurd.

Reference Books: A.A.S.H.O. Policy on Geometric Design—Rural Highways; A.A.S.H.O. Policy on Geometric Design—Urban Highways.

188. Transportation Engineering. M. M. Davis, R. M. Soberman.

Course 1D, IV Year; 2 hrs. lectures per week, first term, 1 hr. lecture per week, second term.

Transportation systems: highway, railroad, shipping, pipelines, conveyors, airports. Structural design of pavements. Theory of traffic flow.

Reference Books: Introduction to Transportation Engineering—Hay; Planning & Design of Airports—Horonjeff; Railroad Engineering—Hay; Soil Mechanics for Road Engineers—D.S.I.R.; Principles of Pavement Design—Yoder; Poisson & Traffic—Eno Fndn.

189. Air Photo Interpretation.

Course 1D, IV Year; 1 hr. lecture per week, first term.

Analysis and interpretation of aerial photographs for the prediction of engineering properties of soils.

191. Soil Mechanics. F. A. De Lory.

Course 1, III Year; 2 hrs. lectures per week, first term.

Identification and classification of soils for engineering purposes; weight volume relationships, compaction; permeability and drainage characteristics; consolidation; field exploration and sampling; stress-deformation characteristics; shearing strength.

Reference Texts: Foundation Design—Teng; Foundation Engineering—Peck, Hanson and Thornburn.

192. Soil Mechanics and Foundations. W. L. Sagar.

Course 1A, C, D, IV Year; 2 hrs. per week, first term, 1 hr. per week, second term.

Shearing strength of soils, consolidation and settlement, slope stability, bearing capacity, footings, retaining walls, braced cuts, piling, dewatering.

Reference Texts: Foundation Design—Teng; Foundation Engineering—Peck, Hanson and Thornburn.

193. Earth Structures and Foundations. F. A. De Lory, E. I. Robinsky.
Course 1D, IV Year; 1 hr. lecture per week, first term, 2 hrs. lectures per week, second term.
Properties of unsaturated soils, fills, embankments, earth and rockfill dams, seepage, flow nets, sheet pile bulkheads, cellular cofferdams, geotechnical processes, tunnels, underpinning.
Reference books: Soil Mechanics in Engineering Practise—Terzaghi and Peck; Pile Foundations—Chellis; Proceedings of Soil Mechanics Conferences.

195. Soil Mechanics and Highway Laboratory. Staff in Civil Engineering.
Course 1 III Year; 3 hrs. per week, first term.
A series of laboratory and problem periods to accompany courses in Soil Mechanics (191) and Highway Engineering I (185).

196. Soil Mechanics Laboratory. W. L. Sagar, F. A. De Lory, E. I. Robinsky.
Courses 1A and 1C, IV Year; 2 hrs. laboratory per week, second term.
Course 1D, IV Year; 2 hrs. laboratory per week, first term.
Laboratory experiments and testing to accompany Soil Mechanics and Foundations (192).
No laboratory reports to be written outside assigned laboratory hours.

197. Air Photo Interpretation Laboratory. J. Vlcek, J. G. Gerrard.
Course 1D, IV Year; 3 hrs. laboratory per week, first term.
Laboratory periods to accompany Air Photo Interpretation (189).

198. Thesis Project, Laboratory and Seminar. Staff in Civil Engineering.
Course 1D, IV Year; 4 hrs. per week, first term; 9 hrs. per week, second term.
Problem and laboratory periods to accompany subjects 140, 188 and 193.

DEPARTMENT OF MINING ENGINERING

201. Assaying. W. A. M. Hewer.
Courses 2, 8, and 9, III Year; 1 hr. lecture per week, both terms.
Theory and practice of fire assaying. Emphasis is laid not only upon the principles of chemistry, metallurgy and sampling involved, but also upon the errors inherent in operators as well as in methods.
References: Manual of Fire Assaying—Fulton and Sharwood.

Textbook of Fire Assaying—Bugbee. Fire Assaying—Shepherd and Dietrich. The Sampling and Assay of the Precious Metals—E. A. Smith.

202. Assaying Laboratory. W. A. M. Hewer.

Courses 2 and 9, III Year; 3 hrs. laboratory per week, both terms.

The determination of precious metals. Scorification, crucible and combination wet and dry methods of assaying ores both simple and complex; milling and metallurgical products including cyanide solutions, cyanide precipitates and gold bullion. Attention is also given to the sampling and assay of ores containing radio-active minerals.

203. Wet Analysis. W. A. M. Hewer.

Course 2, III Year; 3 hrs. laboratory per week, both terms. Analysis of furnace products, base metal, and radioactive ores.

204. Assaying Laboratory. W. A. M. Hewer.

Course 8, III Year; 3 hrs. laboratory per week, first term.

The instruction in general is as described under subject 202, but omitting determinations on precious-metal bullions and radioactive minerals.

221. Mining. H. R. Rice, W. A. M. Hewer.

Courses 2 and 9, II Year; 1 hr. lecture per week, both terms, and 2 hrs. laboratory per week, second term.

A combined lecture and laboratory subject in the principles of mining and its unit processes. Emphasis is placed on the statistical approach to sampling calculations.

222. Mining. H. R. Rice.

Courses 2 and 9, III Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Methods of mine development by mine adits, shafts, drifts and crosscuts; stoping methods, loading, and underground transportation.

223. Mining Laboratory. H. R. Rice, S. E. Wolfe.

Course 2, III Year; 3 hrs. laboratory per week, first term; 2 hrs. laboratory per week, second term.

Special mining problems are given relating to sampling, diamond drilling, stope measurements, the factors affecting the behaviour of broken materials. To develop the individual student's initiative, some special survey problems are worked in the laboratory.

224. Mine Operation and Administration. H. R. Rice.

Courses 2 and 9, IV Year; 2 hrs. lectures per week, both terms.

Lectures on advanced mining practice, including mining methods, ground control, mine mechanization, mine services and plant, aspects of administration and finance, and industrial relations.

225. Mining Laboratory. H. R. Rice.

Course 2, IV Year; 2 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.

A problem which progresses from essential geological data, to a complete design of the related mine, which integrates the principles of mine economics, selection of mining rates, ore-reserve calculations, and plant design.

226. Mining Laboratory. H. R. Rice.

Course 9, IV Year; 3 hrs. laboratory per week, second term.

Problems in mine layout involving shaft location and size; mine development; choice of stoping methods, mining rate, and mine equipment; time and cost schedules; ore reserve calculations.

251. Mine Ventilation Laboratory. The Staffs in Mining and Mechanical Engineering.

Course 2, IV Year; 3 hrs. laboratory per week, first term.

Experiments in the laboratories and problems in the study room to give the student some practice in the use of ventilation test equipment, and the solution of ventilation problems. An aggregate of about ten off-campus study hours may be required in preparation of some reports. This subject relates to subject 321.

241. Mineral Dressing. S. E. Wolfe.

Courses 2 and 8, III Year; 2 hrs. lectures per week, both terms.

The subject deals with the economics of, the theoretical principles and their practical application in, the treatment of ores and mineral aggregates. These involve the processes of crushing, grinding, sizing and classification; gravity, magnetic, and electrostatic separation; and an introduction to froth flotation. In addition, ancillary processes are studied. These include flocculation, sedimentation, filtration, drying of mineral products and the precipitation and collection of dust and fume.

242. Mineral Dressing Laboratory. S. E. Wolfe.

Course 8, III Year; 6 hrs. laboratory per week, second term.

The subject matter in general is as described under Subject 243, but with more emphasis on processes involving surface phenomena.

243. Mineral Dressing Laboratory. S. E. Wolfe.

Course 2, III Year; 6 hrs. laboratory per week, second term.

This work is coordinated with the lecture subject 241. Studies are made of crushing machinery, the principles of crushing and grading of rock products, screen analysis, and the sampling of broken material and mill products. Certain tests with gravity concentrating machines are made and an introduction to the technique of flotation test work is given.

244. Ore Dressing. S. E. Wolfe.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The subjects covered are extensions of those in 241, 242, and 243; cyanidation, flotation processes and techniques, the current practice at milling plants, and problems associated with milling.

245. Ore Dressing Laboratory. S. E. Wolfe.
Course 2, IV Year; 6 continuous hours per week, first term.
Advanced work coordinated with lecture subject 244 and pertaining to ore dressing appliances, the handling in bulk of finely divided solids, the selective flotation of sulphides, ore testing, and pilot plant mill runs.

246. Mineral Dressing. S. E. Wolfe.
Course 9, III Year; 2 hrs. lectures per week, first term.
This abridged subject deals with current practice and fundamental principles in the field of mineral beneficiation.

261. Summer Essay. W. A. M. Hewer.
Course 2, III Year:
An essay, or report, written on a mining topic, preferably some phase of work with which the student is associated during summer employment. Subsequently, each student will deliver a talk to his class on the topic chosen. Thus, training is afforded in both technical writing and public speaking. Students are briefed in advance concerning requirements of this subject.

271. Oral Expression. Mrs. Helen Tucker.
Courses 2 and 9, II Year; 2 hrs. seminar per week, second term.
A seminar series in oral expression. The objective is to improve the ability to speak as a means of communication. Clear expression of sound thinking is discussed and practised in speech assignments.

275. Thesis Project, Laboratory and Seminar. The staff in Mining Engineering.
During the Fourth Year of his Course, each student is required to select an area of investigation suitable to the Department and to give both oral and written findings arising from his pursuit of it. General instructions are given to the student before the close of the preceding Session in order to assist a considered choice.

DEPARTMENT OF MECHANICAL ENGINEERING

302. Engineering Thermodynamics. A. B. Allan.
Course 1, II Year; 2 hrs. lectures per week, second term.
The fundamentals of engineering thermodynamics. The First and Second Laws. Properties of substances. Heat transfer. Heat exchangers. Compressors, fans, pumps, reciprocating engines and turbines. Vapour and gas power cycles. Refrigeration. Air-conditioning.
Text book: Basic Thermodynamics—Brown.

303. Elementary Heat Engineering P. B. Hughes.

Course 3, II Year; 2 hrs. lecture per week, second term.

The history and development of heat engines, the principles upon which they operate, and the characteristic features of the different kinds of engines used in practice. The First and the Second laws of thermodynamics.

Text book: Elements of Thermodynamics and Heat Transfer—Obert and Young.

Reference books: Thermodynamics of Heat Power—Faires. Steam, Air and Gas Power—Severns, Degler and Miles.

306. Engineering Thermodynamics. C. H. Miller.

Course 2, III Year; 1 hr. lecture per week, both terms.

Thermodynamics of gases and vapours as applied to engines, nozzles, turbines, compressors, heat exchangers, refrigeration plants, and air conditioning systems. Analysis of vapour and gas power cycles.

Text book: Thermodynamics of Heat Power—Faires.

307. Heat Engineering Laboratory.

Course 2, III Year; 3 hrs. laboratory per week, second term.

This laboratory is complementary to subject number 306. The testing procedures and evaluation methods applicable to prime mover and compressor equipment are emphasized.

Text book: The Engineering Report in the Undergraduate Laboratory—Hughes.

308. Heat Engineering. F. C. Hooper, W. A. Wallace.

Course 3, III Year; 2 hrs. lecture per week, first term; 1 hr. lecture per week, second term.

Steam Generators. Combustion calculations; analysis of fuels and products of combustion; boiler tests and heat balance; principles of design of boilers, furnaces, stokers, pulverised fuel, oil and gas firing equipment, economizers, air heaters, superheaters, feedwater heaters.

Text book: Power Plant Theory and Design—Potter.

Reference books: Steam Power Plants—Gaffert, McNaughton, Zerban and Nye.

Internal Combustion. Types and operation; performance and testing; basic characteristics and principles of design; carburation; fuel injection; governing.

Text book: The Internal Combustion Engine—Taylor and Taylor.

Reference book: Internal Combustion Engines—Fraas.

Heat Transfer and Air Conditioning. Conduction, convection, radiation, and combined mechanisms of heat transfer. Air and water vapour mixtures, requirements for comfort and industrial processes; the use of psychrometric charts; heating, cooling humidifying and dehumidifying processes; calculation of air conditioning loads; air conditioning systems and equipment.

Reference book: A.S.H.R.A.E. Guide.

309. Engineering Thermodynamics. F. C. Hooper.

Course 3, III Year; 2 hrs. lectures per week, both terms.

A continuation of subject 303.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer. Regeneration.

Text book: Elements of Thermodynamics and Heat Transfer—Obert and Young.

310. Heat Engineering Laboratory.

Course 3, III Year; 3 hrs. laboratory per week, both terms.

This laboratory is complementary to lecture subjects 303, 308 and 309. The experimental work, conducted on a broad range of heat and power equipment, is intended to offer experience in the design, organization and execution of experimental investigations of thermal apparatus, in the application and evaluation of the associated instrumentation, in the treatment of the data, and in the interpretation and reporting of the work.

Text book: The Engineering Report in the Undergraduate Laboratory—Hughes.

311. Engineering Thermodynamics. R. W. P. Anderson

Course 4, III Year; 2 hrs. lectures per week, first term.

The applications of the laws of thermodynamics to ideal processes and cycles using gases and vapours, reversibility, available energy, entropy, properties of fluids. Processes and cycles used in practice for steam and gas power plants, and for refrigerating plants. Reciprocating engines, turbines and compressors. Heat transfer.

Text book: Thermodynamics of Heat Power—Faires.

312. Heat Engineering Laboratory.

Course 4, III Year; 3 hrs. laboratory per week, first term.

This laboratory is complementary to lecture subject 311. Selected experiments are conducted in illustration of the methodology of experimental investigation of the external characteristics of thermal devices and systems, with special attention given to the peculiar interests of the engineer primarily concerned with economic considerations.

Text book: The Engineering Report in the Undergraduate Laboratory—Hughes.

313. Heat Engineering. C. H. Miller

Course 5t, III Year; 2 hrs. lectures per week, both terms.

This course consists of a study of the fundamental concepts of macroscopic thermodynamics, and their applications to closed and open dynamic systems. An examination of the principal power cycles is undertaken in relation to the properties of the working media involved. Emphasis is placed on a thorough understanding of the three basic laws of thermodynamics.

Text book: Concepts of Thermodynamics—Obert

Reference Books: Engineering Thermodynamics—Hall and Ibele.

Thermodynamics—Van Wylen.

314. Heat Engineering Laboratory.

Course 5t, III Year; 3 hrs. laboratory per week, both terms.

This laboratory is complementary to lecture subject 313. The course emphasizes the philosophy and techniques used in the experimental investigation of the performance of heat engineering equipment.

Text book: The Engineering Report in the Undergraduate Laboratory—Hughes.

315. Engineering Thermodynamics. P. B. Hughes.

Course 6, III Year; 2 hrs. lecture per week, first term.

The theory and practice of heat engines, including a study of fundamental principles involved, an appraisal of theoretical developments, and a survey of the corresponding practical applications.

Text book: Thermodynamics of Heat Power—Faires.

316. Heat Engineering Laboratory.

Course 6, III Year; 3 hrs. laboratory per week, second term.

This laboratory is complementary to lecture subject 315. Experiments are conducted on heat engineering equipment presenting testing and control problems similar to those encountered in the process industries.

Text book: The Engineering Report in the Undergraduate Laboratory—Hughes.

317. Thermodynamics. A. B. Allan.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

A development of the fundamental laws of thermodynamics and of their application in engineering. Internal combustion and steam power, refrigeration, heat transfer, psychrometry and air conditioning.

Text book: Thermodynamics of Heat Power—Faires.

318. Heat Engineering Laboratory.

Course 7, III Year; 3 hrs. laboratory per week, first term.

This laboratory is complementary to lecture subject 317. Particular emphasis is placed on the experimental determination of the control and output characteristics of prime movers and of the energy balances in heat power plants.

Text book: The Engineering Report in the Undergraduate Laboratory—Hughes.

321. Mine Ventilation and Allied Problems. R. W. P. Anderson

Course 2, IV Year; 2 hrs. lectures per week, first term.

Ventilation problems in Canadian mines, including the use of ventilation equipment, selection of fans, testing equipment, ventilation studies, the silicosis problem, fire control, etc.

322. Internal Combustion. W. A. Wallace.

Course 3, IV Year; 2 hrs. lectures per week, second term.

A survey of present and potential fuel resources. Characteristics of fuels and their combustion requirements. Operating cycles and losses involved, for both the reciprocating engine and the turbine plant. The theory of superchargers and rotary compressors. Factors governing the selection of equipment for an I.C. plant.

Reference book: The Internal Combustion Engine—Taylor and Taylor.

323. Heat Power Engineering. P. B. Hughes.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

A continuation of subjects 308 and 309. Evaporators and miscellaneous heat exchangers. Condensers and auxiliary power plant equipment. Theory and design of turbines. Power plant cycles including reciprocating engines and turbines. Cycles for high pressures and temperatures. Superheating, reheating, regenerative binary-fluid and supercritical pressure cycles. Steam generators employing forced circulation, indirect evaporation and pressure combustion. Power plant heat balance and efficiencies. Design of power plant equipment. New developments and trends.

Text book: Power Plant Theory and Design—Potter.

Reference books: Heat and Thermodynamics—Zemansky. Engineering Thermodynamics—Obert, Lee and Sears, Soo, Van Wylen, Hawkins and Jones. Steam Power Plants—Gaffert, Zerban and Nye. Steam Turbines—Church, Salisbury, Lee, Shepheard.

324. Heat Engineering Laboratory.

Course 3, IV Year; 3 hrs. laboratory per week, first term, 4½ hrs. laboratory per week, second term.

This laboratory is complementary to lecture subjects 322 and 323. It is an extension of the third year laboratory, subject 310, with an increased demand for individual judgment and a professional outlook.

Text book: The Engineering Report in the Undergraduate Laboratory—Hughes.

325. Refrigeration and Air Conditioning. F. C. Hooper.

Course 5t, IV Year; 2 hrs. lecture per week, first term.

The thermodynamic cycles and processes of special interest in refrigeration are outlined and the properties of ideal and actual refrigerants examined. Basic psychrometric processes are reviewed and related to air conditioning system performance.

Text book: Theory of Mechanical Refrigeration—Sparks and Di Ilio.

Reference book: A.S.H.R.A.E. Guide.

326. Heat Power Engineering. C. H. Miller

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Application of thermodynamics to the design of power plant equipment of all types including gas turbines, subcritical and supercritical vapour cycles, and combinations thereof. New developments and trends are emphasized by consideration of the problems associated with nuclear reactor energy sources, magnetoplasmadynamics power generation, fuel cells and extra-terrestrial environmental conditions. Departures of real cycles from idealized analytical models are considered in some detail.

References: Cycles and Performance Estimation—Hodge. Analytical Thermodynamics—Soo. Power Plant Theory and Design—Potter. Selected Papers from Current Literature.

327. Internal Combustion. A. B. Allan.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Analysis of the processes and fundamental problems of internal combustion machines. Consideration of the deviations from ideal behaviour. Fuels, combustion, ignition, detonation and other combustion problems. Experimental techniques in the study of internal combustion machines. A consideration of engine design.

Text book: Internal Combustion Engines—Obert.

Reference book: Internal Combustion Engines—Lichty.

328. Heat Transfer. F. C. Hooper.

Courses 5t and 5n, IV Year; 2 hrs. lecture per week, second term.

Steady state and transient conduction, surface and gas radiation, convection, boiling, condensation and combined mechanisms are considered. Special attention is given to analogue and computational procedures and to consideration of the manner in which novel or complex problems may be approached.

Text book: Heat Transmission—McAdams.

329. Heat Engineering Laboratory.

Course 5t, IV Year; 3 hrs. laboratory per week, both terms.

This laboratory is complementary to lecture subjects 325, 326, 327 and 328, and an extension of laboratory subject 314. The laboratory offers an opportunity for specialized individual undertakings.

330. Heat Transfer. C. H. Miller.

Course 8, IV Year; 2 hrs. lectures per week, first term.

Basic principles, definitions, units and dimensional analysis. Conduction in the steady and the unsteady states. The heat source within a conducting body. Free and forced convection. Condensing and boiling. Radiation. Combined effects of conduction, convection and radiation. Instrumentation and experimental methods.

Text book: Heat Transfer—Chapman.

333. Fluid Mechanics. G. R. Lord, H. J. Leutheusser.

Courses 1 and 3, III Year; 2 hrs. lectures per week, both terms.

Attention is given to the development and discussion of the fundamental principles of fluid flow. These principles are illustrated by suitable practical problems connected with fluid measurements, flow of fluids in pipes and open channels, with a brief discussion of the resistance of submerged bodies, dimensional analysis and similarity studies.

334. Fluid Mechanics Laboratory

Courses 1 and 3, III year; one 3 hr. laboratory period per week, second term.

This laboratory course is planned to illustrate the principles considered in the lecture courses in fluid mechanics. Experimental work in the laboratory utilizes a wide variety of apparatus and equipment concerned with fluid flow, while problems undertaken in the study room provide a link with general engineering practice.

335. Fluid Flow and Pumping Systems. E. Brundrett.

Course 2, III Year; 3 hrs. lectures per week, first term.

A discussion of the fundamental principles of fluid flow, with special attention to problems encountered in mining.

336. Fluid Flow and Pumping Systems Laboratory.

Course 2, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit correlation of flow fundamentals with mining applications.

337. Fluid Mechanics. E. Brundrett, W. M. Mansour.

Courses 4 and 6, III Year; 2 hrs. lectures per week, first term.

The fundamentals of fluid flow as generally encountered in industry. Fluid properties, fluid statics, energy relations, dimensional analysis and dynamic similarity, flow in pipes and channels, resistance of submerged bodies, effects of viscosity and compressibility, lubrication, pumps and other hydraulic machines.

338. Fluid Mechanics Laboratory.

Courses 4 and 6, III Year; 3 hrs. laboratory per week, first term.

A course of laboratory experiments and design problems to permit of correlating flow fundamentals with industrial applications.

341. Hydraulic Engineering. W. D. Baines.

Course 1, IV Year, Option C; 2 hrs. lectures per week, both terms.

Applications of fluid mechanics to civil engineering problems, particularly discussion of flow in pipes and open channels, surge tanks, water hammer, pumps and turbines. Theory and applications of hydrology including precipitation, run-off, snowmelt, ground water, evaporation and hydrograph analysis.

342. Hydraulic Engineering Laboratory.

Course 1, IV Year, Option C; one 1½-hr. laboratory period per week, first term; one 3-hr. laboratory period per week, second term.

Experimental studies of hydraulic models, turbines and pumps are carried out. Problems assigned in the study rooms deal with channel flow and other hydraulic features connected with water power installations, flood control, water supply and drainage systems.

343. Hydraulic Engineering. L. E. Jones, H. J. Leutheusser.

Course 1, IV Year, Options A, B, D; 2hrs. lectures and 3 hrs. laboratory per week, second term.

The general field of hydraulic engineering is studied under the topics: hydrology; ground and surface water; drainage, flood control, power and navigation systems; municipal and industrial applications; model studies; principles of design, operation, and field investigation.

344. Hydraulics. G. R. Lord.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

The general field of applied hydraulics and fluid mechanics is studied under the topics: hydrology; hydro-electric power plants and auxiliaries; conservation and flood control; canals, pipelines, etc., under both steady and unsteady conditions; hydraulic machinery, fans, compressors, turbines, pumps, etc., design, selection and operation; power and control circuits; flow of compressible fluids; similarity and model investigations; industrial applications.

345. Hydraulic Laboratory.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 4½ hrs. laboratory per week, second term.

Experimental work is carried out in the laboratory on various types of pumps, turbines, fans, centrifugal compressors and on hydraulic models. In addition computation problems involving open channel flow, water power studies, pumps and turbine studies, water hammer phenomena, fans and ductwork and other advanced flow problems are considered. General problems involving compressibility of gases are considered.

346. Fluid Mechanics. H. J. Leutheusser.

Course 7, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Physical characteristics of fluids; fundamental concepts of fluid mechanics; experimental techniques and principles of systematic analysis; boundary layers, wakes and turbulence; pipe and channel systems; dynamics of compressibility; oscillations and waves; forces and moments on immersed bodies; fluid machinery; introduction to systems encountered in engineering practice.

347. Fluid Mechanics Laboratory.

Course 7, IV Year; 3 hrs. laboratory per week, second term.

Laboratory experiments and design problems to illustrate subject 346.

350. Dynamics. G. E. Godfrey.

Courses 1 and 4, II Year; 2 hrs. lectures per week, second term.

Motion of a point is reviewed and extended to include Coriolis' acceleration, with applications. Equations for motion of mass in translation, rotation, and plane motion are developed, including centre of percussion. Moment of inertia of mass is studied by double integration and by the lamina method. The derivation and application of gyroscopic action is thoroughly discussed, and an introduction to static and dynamic balancing is given. Elementary vibration theory and problems in vibration isolation are discussed.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics—Part II—Meriam.

351. Dynamics. M. A. Dokainish.

Course 5, II Year (elective); 2 hrs. lectures per week, first term.

Simple particle motion. Work and energy. Impulse and momentum. Kinematics of plane motion and Coriolis acceleration. Kinetics of translation and rotation. General kinetics of plane motion. Gyroscopic action. Simple vibrations. Gibbs' Vector Notation.

Text book: Mechanics, Part II—Meriam.

Reference book: Engineering Dynamics—Hooper and Smith.

352. Dynamics. F. P. J. Rimrott.

Course 7, II Year; 2 hrs. lectures per week first term; 1 hr. lecture per week, second term.

Motion of a point, including Coriolis' acceleration; motion of mass; gyroscopic action; vibration and balancing; electro-mechanical analogies; Gibb's vector notation.

Text book: Engineering Dynamics—Hooper and Smith.

Reference book: Mechanics, Part II—Meriam.

353. Dynamics Laboratory. F. P. J. Rimrott.

Course 7, II Year; 1½ hrs. problems per week, both terms.

Problems in kinematics and kinetics to support subject 352.

355. Mechanical Engineering. R. T. Waines.

Course 3, II Year; 1 hr. lecture per week, first term.

Prior to registering in Second Year, the student is required to study the prescribed text, covering the topics of design materials and manufacturing methods and processes. The lecture work will involve discussion of the text matter, as well as new materials and processes. The final examination (in January) will cover both the prescribed study and the lecture work.

Text book: Manufacturing Processes and Materials for Engineers—Doyle, Morris, Leach and Schrader.

356. Machine Design. I. W. Smith.

Course 3, II Year; 2 hrs. lectures per week, second term.

Design of machine elements—shafts, bearings, belts, couplings, clutches.

Text book: Design of Machine Elements—Spotts.

357. Dynamics of Machines. D. L. Allen.

Course 3, II Year; 3 hrs. lectures per week, both terms.

Basic equations for accelerated motion of mass are developed and applied to the analysis of machine elements. Velocity, acceleration, force distribution, speed fluctuation and balancing of machines are considered. Standard linkages, cams, gears, flywheels, governors and gyroscopes are given specific attention.

Text books: Engineering Dynamics—Hooper and Smith. Kinematics and Dynamics of Machinery—Maxwell.

358. Machine Design Laboratory. R. T. Waines, D. L. Allen, C. L. Proctor.

Course 3, II Year; 6 hours per week, both terms.

Problems in mechanical drawing, descriptive geometry, fits and tolerances, machine tool operations, dynamics of machines, metrology, and design of machine elements.

Text book: Engineering Drawing—French and Vierck, 9th edition.

359. Mechanical Design. R. T. Waines.

Course 4, II Year; 1 hr. lecture per week, both terms.

Machines and Processes. In addition, standards, allowances and fits, metrology and machine tool operations.

Text book: Manufacturing Processes and Materials for Engineers—Doyle, Morris, Leach and Schrader.

360. Mechanical Design Laboratory. R. T. Waines, B. M. M. Carpendale.

Course 4, II Year; 6 hrs. per week, both terms.

Problems in mechanical drawing, descriptive geometry, fits and tolerances, machine tool operations, machine force analysis, and metrology, the latter being given in the Fine Measurement Laboratory.

Text book: Engineering Drawing—French and Vierck, 9th edition.

363. Machine Design. I. W. Smith.

Course 3, III Year; 2 hrs. lectures per week, first term.

Stress analysis, deflections, failure theory, fluctuating stress, and the design of various machine elements, including screw threads for fastening, shafting, bearings, belts, pulleys, spur gears, flywheels, keys, clutches, etc.

Text book: Design of Machine Elements—Spotts.

364. Machine Design Laboratory. R. T. Waines, I. W. Smith.

Course 3, III Year; 6 hrs. per week first term, 3 hrs. per week second term.

Design and stress analysis of machine elements; vibration problems and experiments in one and two mass systems.

365. Applied Elasticity. J. VandeVegte.

Courses 5n, 5p, 5t, III Year; 1 hr. lecture per week, both terms.

Introduction (simple equations for normal and shear stresses; stress concentrations; fluctuating stresses and fatigue). Analysis of stress and strain in three dimensions, including use of primary and auxiliary Mohr's circles, and application to bending and torsion problems. Deflection analysis of statically determinate and indeterminate structures. Additional topics and applications include: Analysis of plates and shells, torsion of thin-walled tubes, stability of columns, thermal stresses.

366. Applied Elasticity Laboratory. I. W. Smith, R. T. Waines, J. VandeVegte.

Courses 5n, 5p, 5t, III Year; 3 hrs. laboratory per week, both terms.

Problems to support subject 365.

367. Machine Design. G. E. Godfrey.

Course 7, III Year; 2 hrs. lectures per week, first term.

Force analysis; mechanics; velocities, accelerations and inertia forces in machines; principles of stress analysis and the design of various machine elements, including shafting, bearings, belts, gears, etc.; also an introduction to work on speed fluctuation, vibrations and balancing.

Text book: Design of Machine Elements—Spotts.

368. Machine Design Laboratory. R. T. Waines, G. E. Godfrey.

Course 7, III Year; 3 hrs. per week, first term.

Design and stress analysis of machine elements. In the laboratory, the student is given an opportunity to apply the subject material of the lectures to various machine design problems.

371. Machine Design. C. L. Proctor.

Courses 2 and 8, IV Year; 1 hr. lecture per week, both terms.

The design and selection of machinery and equipment met with in metallurgical plants, and in mining work.

Text book: Design of Machine Elements—Spotts.

372. Machine Design Laboratory. I. W. Smith, R. T. Waines.

Courses 2 and 8, IV Year; 3 hrs. laboratory per week, second term.

Problems worked out in the laboratory, designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for metallurgical apparatus, and mine machinery.

373. Machine Design. I. W. Smith.

Course 3, IV Year; 2 hrs. lectures per week, both terms.

This is a continuation of subjects 363 and 357. It will involve

the design of various machine elements and equipment including machine frames, hooks, hoisting equipment, crankshafts, gears (helical, herringbone, bevel, screw, and worm), springs, clutches, brakes, thin and thick wall vessels.

An introduction will be given to the study of vibration problems encountered in high speed engines and machines.

Text books: Design of Machine Elements—Spotts. Mechanical Vibrations—Thomson.

374. Machine Design Laboratories. I. W. Smith, R. T. Waines.

Course 3, IV Year; 3 hrs. laboratory per week, first term; 4½ hrs. laboratory per week, second term.

Advanced laboratory work involves both analysis and design of machine elements, machine units, and complete machines. The selection of problems is made with a view to giving the student as broad a coverage as possible and providing experience in combining of elements to form a machine of smooth and harmonious design. Some of this work will involve special shafting problems including graphical solutions, critical speeds, and multiple supports.

Work will be given in the Mechanical Laboratory on gauging and fine measurements, experimental stress analysis, vibration, and bearing testing.

375. Machine Design. G. E. Godfrey.

Course 4, IV Year; 2 hrs. lectures per week, both terms.

Force analysis; mechanics, velocities, accelerations and inertia forces in machines; stress analysis; deflections; failure theory; fluctuating stress, and design of various machine elements including shafts, bearings, belts, gears, riveted and welded parts, etc.; also an introduction to speed fluctuation and vibrations.

Text book: Design of Machine Elements (third edition)—M. F. Spotts.

376. Machine Design Laboratory. R. T. Waines, G. E. Godfrey.

Course 4, IV Year; 3 hrs. per week, both terms.

Design and stress analysis of machine elements. In the laboratory, the student is given an opportunity to apply the subject material of the lectures to various machine design problems.

377. Machine Design. J. VandeVegte.

Course 5t, IV Year; 2 hrs. lectures per week, second term.

A series of lectures on design methods related to heat engines, including force analysis, speed fluctuation, flywheel design, governors, vibrations, high speed bearings, and thermal stress.

Reference books: Mechanism and Dynamics of Machinery—Mabie and Ocvirk. Analysis and Lubrication of Bearings—Shaw and Macks. Design of Machine Elements—Spotts.

378. Machine Design. R. T. Waines.

Course 6, IV Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

The design of various machine elements, particularly those likely to be met with in chemical plants, and an outline of the properties, production methods, and selection of materials used in machine equipment.

Reference books: Process Equipment Design—Hesse and Rushton. Principles of Machine Design—Berard, Waters and Phelps. Design of Machine Elements—Faires.

379. Machine Design Laboratory. I. W. Smith, R. T. Waines.

Course 6, IV Year; 3 hrs. laboratory per week, second term.

Problems worked out in the laboratory, designed to give the student training in the general lay-out of shafting and plant machinery, as well as in the design of simple parts for chemical apparatus.

383. Mathematical Analysis. Staff in Mechanical Engineering.

Courses 3 and 4, II Year; 1½ hrs. problems per week, both terms.

Solution of engineering problems by mathematical analysis, with particular reference to the work of subject 2420.

386. Engineering Analysis. Staff in Mechanical Engineering.

Course 3, III Year; 1½ hrs. problems per week, first term; 3 hrs. problems per week, second term.

Exercises in reducing physical problems to analytical statements, with emphasis on the formulation of differential equations, the solutions of the mathematical problems involved, and the physical interpretation of these solutions; assessment of the validity of mathematical models.

Reference books: Engineering Analysis—verPlanck and Teare; Creative Engineering Analysis—Ryder.

387. Treatment of Technical Data. L. E. Jones.

Course 3, III Year; 2 hrs. lectures per week, and 3 hrs. problems per week, second term.

Presentation of data; approximate nature of technical data; role played by mathematics; general numerical methods including FORTRAN computer language; methods of organizing data for computation; methods of analyzing technical data; elements of curve-fitting and statistical treatment.

390. Applied Mathematics in Engineering. Staff in Mechanical Engineering.

Course 3, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term; 3 hrs. problems per week, both terms.

Dimensional analysis and similarity, numerical methods, relaxation techniques, approximate solutions, digital and analogue com-

putation, including FORTRAN computer programming, introduction to statistics and operations research.

391. Elementary Control Theory. J. VandeVegte.
Course 3, IV Year; 1 hr. lecture per week, both terms.
An introduction to the principles utilized in the analysis of linear control systems. Emphasis is also placed on the synthesis of mathematical models of simple systems, and the limitations inherently involved. Topics include stability criteria, characteristics of electrical, pneumatic and hydraulic control elements, and capabilities of feedback systems. A brief introduction to the problems arising from non-linear prototypes is included.
Recommended text: Automatic Control Engineering—Raven.

392. Elementary Control Theory Laboratory. J. VandeVegte, W. M. Mansour.
Course 3, IV Year; 3 hrs. laboratory per week, second term.
Problems and experiments related to subject 391 are dealt with.

393. Computational Methods. L. E. Jones.
Course 5t, IV Year; 1 hr. lecture per week, 3 hrs. problems per week, first term.
Practical extension of Subjects 2427 and 2428 to provide advanced computing experience with desk calculators and with analogue and digital computers. FORTRAN computer language will be studied in detail. Emphasis is placed on the economic use of available numerical procedures in the solution of engineering problems.

396. Industrial Management. B. M. M. Carpendale, P. B. Hughes.
Courses 3, 6, 7, IV Year; 1 hr. lecture per week, first term.
Introduction to principles of management and organization.
Subjects 3440 and 396 are combined in one examination.

DEPARTMENT OF INDUSTRIAL ENGINEERING

401. Operations Research I. The Staff in Industrial Engineering.
Course 4, IV Year; 2 hrs. lectures per week, both terms.
Methods of determining economic optima in industrial operations. Applications of mathematical techniques such as Lagrange multipliers, linear programming, non-linear programming, dynamic programming, to problems in production scheduling and sequencing, inventory control, transportation, equipment investment, utilization of scarce resources, and so on.
Recommended text: Concepts in Management Science, Donald J. Clough, Prentice-Hall Inc.

402. Operations Research I Laboratory. The Staff in Industrial Engineering.
Course 4, IV Year; 3 hrs. laboratory per week, both terms.
Practical work to accompany subject 401. Case studies and problem assignments.

403. Operations Research II. The staff in Industrial Engineering.

Course 4, IV Year; 2 hrs. lectures per week, first term.

Applications of probability theory and statistical analysis to problems in industrial operations. Markov theory applied to queuing, inventory, maintenance, and machine replacement problems. Statistical methods of estimation applied to the same problem areas.

Recommended text: Concepts in Management Science, Donald J. Clough, Prentice-Hall Inc.

404. Operations Research II Laboratory. The Staff in Industrial Engineering.

Course 4, IV Year; 3 hrs. laboratory per week, first term.

Practical work to accompany subject 403. Case studies and problem assignments.

405. Dynamics of Industrial Systems. D. J. Clough.

Course 4, IV Year; 2 hrs. lectures per week, second term.

The design and analysis of industrial systems, with particular emphasis on dynamic feedback models to simulate system behaviour. (Also see subject 406.)

406. Dynamics of Industrial Systems Laboratory. D. J. Clough.

Course 4, IV Year; 3 hrs. laboratory per week, second term.

The M.I.T. Dynamo compiler is used in conjunction with the I.B.M. 7090 computer to simulate the dynamic behaviour of the systems dealt with in subject 405.

407. Elementary Control Theory. A. Porter.

Course 4, IV Year; 2 hrs. lecture per week, both terms.

The dynamic behaviour of simple linear mechanical and electrical networks; weighting functions and transfer functions of linear elements; the principles of analogue and digital computers; introduction to Boolean Algebra and its applications; elements of information theory and its control implications; introduction to linear servomechanisms and manually operated control systems.

408. Elementary Control Theory Laboratory. A. Porter, L. Magagna.

Course 4, IV Year; 3 hrs. laboratory per week, both terms.

Problems and laboratory experiments related to subject 407.

409. Current Developments in Industrial Engineering. The Staff in Industrial Engineering.

Course 4, IV Year; 2 hrs. lectures per week, second term.

A selection of topics emphasizing subjects of current technical interest in the field of Industrial Engineering. The interdisciplinary character of Industrial Engineering will guide the choice of specific treatment, perhaps from the fields of control theory, information theory, computer developments, management systems, biomedical problems, etc.

410. Current Developments Laboratory. The Staff in Industrial Engineering.

Course 4, IV Year; 2 hrs. laboratory per week, second term.

Readings in the topics of course 409 from the current technical literature will be assigned and two short essays will be required of each student.

411. Industrial Engineering Seminar.

Course 4, IV Year; 2 hrs. laboratory per week, second term.

Invited speakers, prominent in the Academic, Governmental, and Business communities, will conduct a series of talks followed by general discussion. An essay based on one of these sessions will be required.

412. Operations Research. A. Porter, J. W. Abrams.

Course 2, III Year; 2 lectures per week, first term.

The history of operations research; introduction to statistical mathematics; selected topics in O.R. methodology, e.g., replacement theory, inventory theory, transportation theory, queuing theory; introduction to electronic data processing.

413. Operations Research Laboratory. A. Porter, J. W. Abrams.

Course 2, III Year; 1½ hrs. per week, first term.

Problems and case histories associated with subject 412.

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

600. Chemistry. The Staff in Chemical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

Chemical theory, with industrial and engineering applications.

601. Chemical Laboratory. W. F. Graydon, J. Binkiewicz.

Courses 1, 2, 3, 4, 5, 6, 7, 8 and 9, I Year; 3 hrs. laboratory per week, both terms.

A laboratory course illustrating the fundamental laws of chemistry as dealt with in the lecture course, and providing an introduction to chemical analytical methods.

602. Chemistry. W. H. Burgess.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Introductory physical chemistry: the gas laws, chemical equilibria, elementary solution chemistry, thermochemistry. Problems dealing with industrial and engineering applications.

605. Chemistry. W. F. Graydon, A. J. Szonyi.

Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.

Calculations based on systems in equilibrium; examples from pH, solubility, complex formation and phase equilibrium.

606. Analytical Chemistry Laboratory. W. F. Graydon, A. J. Szonyi.
Courses 2 and 9, II Year; 6 hrs. laboratory per week, first term.
Volumetric and gravimetric analysis.

607. Engineering Chemistry. W. H. Rapson, S. Sandler.
Courses 1, 3, and 4, II Year; 2 hrs. lectures per week, first term.
Corrosion and water-treatment; introduction to organic chemistry.

608. Physical Chemistry. R. W. Missen.
Course 5, II Year; 2 hrs. lectures per week, both terms.
A continuation of subject 602. Topics discussed include phase and reaction equilibrium, the latter following an introduction to chemical thermodynamics, reaction kinetics and electrochemistry.
Text book: Physical Chemistry—Daniels and Alberty—2nd edition.

609. Chemistry Laboratory. Staff in Chemical Engineering.
Course 5, II Year; 3 hrs. laboratory, alternate weeks, both terms.
Laboratory exercises to accompany subject 608.
Ten laboratory reports.

610. Chemical Engineering Science Laboratory. Staff in Chemical Engineering.
Course 5, II Year (elective) ; 3 hrs. laboratory per week, second term.
An experimental introduction to physical rate processes. Electrical, fluid flow, heat transfer, and mass transfer systems with varied capacities are used to illustrate the dependence of the rate of transfer on driving force, resistance, etc.
Three laboratory reports.

613. Analytical Chemistry Laboratory. I. H. Spinner, C. P. Brockett.
Course 6, II Year.
This course commences on the Wednesday following the first Monday in September, and continues until the opening of the Fall Term. All the working time will be spent on systematic quantitative inorganic analysis.
Text book: Textbook of Inorganic Analysis—Kolthoff and Sandell.

614. Analytical Chemistry Laboratory. I. H. Spinner, C. P. Brockett.
Course 6, II Year; 9 hrs. laboratory per week, first term.
A continuation of Subject 613.

615. Analytical Chemistry. I. H. Spinner.
Course 6, II Year; 2 hrs. lectures per week, first term.
Equilibrium considerations in quantitative analysis.

616. Industrial Chemistry. W. G. MacElhinney.
Course 6, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.
Manufacture of acids, alkalis, and inorganic chemicals; water-treatment, corrosion, explosives.

617. Inorganic Chemistry. R. E. Jervis.
Courses 6 and 8, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
The constitution of matter and classification of the elements: systematic inorganic chemistry.

618. Organic Chemistry. J. G. Breckenridge.
Course 6, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.
An introductory course in organic chemistry, with emphasis on reaction conditions and yields, and the industrial significance of certain compounds and reactions.
Text book: Systematic Organic Chemistry—Muldoon and Blake.

619. Chemical Engineering Science Laboratory. I. H. Spinner, C. P. Brockett, R. L. Hummel, J. W. Smith.
Course 6, II Year; 10½ hrs. laboratory per week, second term.
Experiments illustrating the kinetic and equilibrium principles of chemical engineering. Mass and heat balance calculations.
One laboratory report per week.

625. Chemical Theory A. W. H. Burgess, W. F. Graydon.
Course 6, III Year; 1 hr. lecture per week, both terms.
Chemical kinetics; principles of adsorption and colloid chemistry.

626. Chemical Theory B. W. H. Burgess, W. F. Graydon.
Courses 5c and 6, III Year; 2 hrs. lectures per week, both terms.
Chemical thermodynamics, introductory to subject 655.

627. Chemical Laboratory. W. F. Graydon, Z. May.
Course 6, III Year; 6 hrs. laboratory per week, both terms.
A laboratory course to accompany subject 626.
One laboratory report.

628. Organic Chemistry. J. G. Breckenridge.
Course 6, III Year; 2 hrs. lectures per week, both terms.
A continuation of subject 618, dealing mainly with aromatic compounds.

629. Organic Chemistry Laboratory. W. H. Rapson, Z. May.
Course 6, III Year; 9 hrs. laboratory per week, first term; 6 hrs. laboratory per week, second term.
A laboratory course accompanying subject 628.

630. Industrial Chemistry. W. G. MacElhinney, W. H. Rapson.

Course 6, III Year; 3 hrs. lectures per week, second term.

Chemical process industries, including petroleum, soap, sugar, pulp and paper, and fermentation industries. In preparation for this course, students will be expected to have read and to be thoroughly familiar with the following: Chemical Process Industries—Shreve: Chapters 29, 30, 31, 33, 34, 37.

631. Introduction to Mass and Heat Transfer. W. G. MacElhinney.

Course 6, III Year; 2 hrs. lectures per week, both terms; 3 hrs. laboratory per week, second term.

The fundamental theory and practice used in transfer operations in chemical engineering. Energy and mass transfer are considered in the study of the flow of fluids, fluidization of solids, heat transfer, and evaporation of solutions.

Text book: Principles of Unit Operation—Foust, Wenzel, Clump, Maus, and Andersen.

632. Public Speaking. W. H. Rapson, S. Sandler, M. Wayman.

Course 6, III Year; 1 hr. per week, both terms.

633. Applied Mathematics in Chemical Engineering. R. L. Hummel, R. W. Missen, I. H. Spinner.

Course 6, III year; 1 hr. lecture and 1hr. problem period per week, both terms.

A course in the formulation of differential equations describing typical chemical engineering situations. The solution of these equations will be obtained primarily by analogue and numerical methods. The second part is a course in the attack and solution of problems in applied chemistry and chemical engineering requiring a knowledge of the rational design of experiments and the treatment of experimental data.

640. Chemical Engineering Thermodynamics. W. F. Graydon.

Course 5c, III Year; 2 hrs. lectures per week, both terms.

A course in classical thermodynamics with problems in the field of applied chemistry and chemical engineering. Special emphasis is placed on chemical processes and compositional changes.

641. Chemical Engineering Rate Processes. O. Trass.

Course 5c, III Year; 3 hrs. lectures per week, both terms.

The kinetic theory of gases. Mechanisms and rates of homogeneous chemical reactions. Physical transport mechanisms and estimation of transport properties. Application to reaction kinetics and momentum, heat, and mass transfer.

642. Chemical Engineering Problems and Laboratory. Staff in Chemical Engineering.

Course 5c, III Year; 9 hrs. per week, both terms. Problems and laboratory experiments illustrating topics discussed in Subjects 640 and 641.

650. Mass Transfer Operations. O. Trass.

Courses 5c and 6, IV Year; 2 hrs. lectures per week, both terms.

The theory and practice of mass transfer operations in chemical engineering are discussed. Many problems in distillation, extraction, absorption, and other operations illustrate the course.

Text book: Mass Transfer Operations—R. E. Treybal.

651. Chemical Plant Design. R. W. Missen, J. W. Smith, M. Wayman.

Course 6, IV Year; 1 hr. lecture per week first term; 3 hrs. laboratory per week, second term.

The lectures deal with selected topics in plant design: process design, plant location, economics. In the second term, process design calculations are done for a particular plant, ending with an economic evaluation of the process. If possible, a visit is made to a nearby operating plant to illustrate the work done in the laboratory.

Text book: Chemical Engineering Plant Design—Vilbrandt and Dryden.

Reference book: Chemical Engineering Cost Estimation—Aries and Newton.

652. Chemical Engineering Laboratory. R. L. Hummel, W. G. MacElhinney, J. W. Smith, O. Trass.

Courses 5c and 6, IV Year; 9 hrs. laboratory per week, first term.

A laboratory course to accompany subjects 631, 650, and 651. Bench and pilot plant experiments are carried out to study a variety of unit operations such as fluidization, heat transfer, evaporation, filtration, distillation, extraction, and absorption. Modern control instruments are discussed and operated.

One laboratory report per week.

653. Applied Mathematics in Chemical Engineering. R. W. Missen.

Course 6, IV Year; 3 hrs. laboratory per week, first term.

A problems course dealing with selected topics in dimensional, graphical and numerical methods, statistics and differential equations.

Reference books: Applied Statistics for Engineers—Volk; Applied Mathematics in Chemical Engineering—Mickley, Sherwood and Reed; Nomography and Empirical Equations—Davis.

654. Organic Chemistry. W. H. Rapson.

Course 6, IV Year; 1 hr. lecture per week, both terms.

The chemistry of natural and synthetic high-molecular-weight materials.

655. Chemical Engineering Thermodynamics and Kinetics. W. H. Burgess, W. F. Graydon.

Course 6, IV Year; 2 hrs. lectures per week, both terms.

The application of thermodynamics and kinetics to problems in the field of chemical engineering.

660. Organic Chemistry. J. G. Breckenridge, I. H. Spinner.

Course 5c, IV Year; 3 hrs. lectures per week, first term.

A lecture course in organic chemistry, concluding with a section on the chemistry of high polymers.

661. Organic Chemistry Laboratory. J. G. Breckenridge, Z. May.

Course 5c, IV Year; 6 hrs. laboratory per week, second term.

A laboratory course to accompany subject 660.

663. Instrumental Methods. S. Sandler.

Course 5c, IV Year; 2 hrs. lectures per week, second term.

The subject is designed to emphasize the science of chemical instrumentation. The principles, technique, and applications of gas-chromatographic, opticometric, electrometric, and mass-spectrometric methods of analysis are studied.

664. Process Dynamics.

Course 5c, IV Year; 2 hrs. lectures per week, both terms, 3 hrs. laboratory per week, second term.

Measurement and control of process variables; mathematical principles, instrumentation, and control systems.

Application of analogue and digital computers to chemical process simulation and optimization.

665. Chemical Engineering Thermodynamics and Kinetics. W. H. Burgess, W. F. Graydon.

Course 5c, IV Year; 3 hrs. lectures per week, both terms.

The application of the principles of chemical thermodynamics and reaction kinetics to chemical processes. Special emphasis is placed on the sizing and design of chemical reactors and the thermodynamic properties of non-ideal systems.

666. Chemical Engineering Design. J. W. Smith and Staff in Chemical Engineering.

Course 5c, IV Years; 2 hrs. lectures and 6 hrs. laboratory per week, both terms.

Applications of heat transfer and fluid flow, process economics, optimal design, and applied mathematics in chemical engineering, chemical plant design. In the first term the laboratory is devoted to problems in these topics and in those of Subject 665; in the second term process design calculations and an economic evaluation are done for a particular chemical plant.

Reference books: Plant Design and Economics for Chemical Engineers—Peters. Applied Mathematics in Chemical Engineering—Mickley, Sherwood, and Reed. Chemical Engineer's Handbook—Perry.

670. Nuclear Engineering. D. G. Andrews, R. E. Jervis.

Course 5n, IV Year; 2 hrs. lectures per week, both terms.

Nuclear engineering aspects of: nuclear constitution and properties including cross-section, energetics, radioactivity, production

and use of radio-isotopes, neutrons, slowing down, "age" theory, diffusion of thermal neutrons, fission.

The age and two-group theories of the reactor core. Reflected reactors (elementary treatment). Reactor kinetics, control and instrumentation.

Applications of heat transfer, fluid flow and stress analysis to the reactor core.

The measurement and control of radiation. Exposure of humans to radiation. Shielding techniques.

Nuclear engineering applications of nuclear and radio-chemistry.

671. Nuclear Engineering Laboratory. D. G. Andrews, R. E. Jervis.

Course 5n, VI Year; 3 hrs. laboratory per week, both terms.

A laboratory course to accompany subject 670.

Experiments are carried out with radiation sources and instruments, a sub-critical reactor, a reactor simulator, pulse height analyzers, fast neutrons generators and radioactive tracers.

DEPARTMENT OF ELECTRICAL ENGINEERING

700. Electricity. Staff in Electrical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism, including Kirchhoff's Laws and network theorems as applied to direct-current circuits, induced voltages, self and mutual inductance and an introduction to electric field concepts. The MKS system of units is used.

701. Electricity. Staff in Electrical Engineering.

Course 5, I Year; 2 hrs. lectures per week, both terms.

A basic course in electricity and magnetism that is similar to subject 700 but adapted to the needs of Course 5.

710. Electric Circuits I. A. J. Kravetz.

Course 7, II Year; 3 hrs. lectures per week both terms; 2 hrs. computation, alternate weeks, both terms.

The relation of lumped parameters to field concepts, their physical realization and their variation with frequency. The representation of simple systems by lumped parameter circuits.

The analysis of linear circuits in the steady state with either direct or alternating sources. Loop and nodal methods. The elements of the topography of circuits. Coupled circuits. Response of circuits to variable frequency.

The transient response of simple linear circuits to suddenly applied sources and its relation to the steady state.

Three-phase circuits, balanced and unbalanced. Other polyphase circuits.

General network theorems, rigorously derived, including the transformation theorems.

711. Electric and Magnetic Fields. G. R. Slemon.

Course 7, II Year; 2 hrs. lectures per week, both terms; 2 hrs. computation, alternate weeks, both terms.

Electric and magnetic fields, forces and energies associated with charged and current-carrying conductors embedded in dielectric and magnetic media. Particle dynamics in electric and magnetic fields. Time-varying fields in conductors and insulators. Development of Maxwell's equations and interpretation in static and dynamic situations.

Text book: Scientific Basis of Electrical Engineering—Ham and Slemon.

712. Electrical Measurements. H. A. Courtice.

Course 7, II Year; 2 hrs. lectures per week, second term.

Measurement of electrical quantities such as charge, potential difference, current, magnetic flux, energy and power. Measurement of electrical properties such as dielectric constant, permeability and conductivity. Measurement of resistance inductance and capacitance. Transducers for electrical measurement of mechanical, thermal and other physical quantities. Measurement of alternating-current quantities in single phase and polyphase systems. Accuracy of measurement, curve fitting and treatment of measured data.

713. Electrical Laboratory.

Courses 3 and 4, II Year; 3 hrs. laboratory per week, first term.

Course 7, II Year; 3 hrs. laboratory per week, both terms.

Appropriate laboratory experiments to accompany subjects 710, 712, and 714.

Courses 3 and 4. Six laboratory reports.

Course 7. Ten laboratory reports.

714. Electricity. H. A. Courtice.

Courses 3 and 4, II Year; 2 hrs. lectures per week, first term.

General principles and calculations of electrical circuits, particularly as applied to the measurement of resistance, current, potential difference, inductance, capacity, power, and energy. The principles underlying commercial instruments are considered, together with the methods of calibration.

Reference books: Electrical Measurements—Laws. Basic Electrical Measurements—Stout.

715. Electric Circuits. A. J. Kravetz.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Circuits as models for physical devices. Kirchhoff's laws. Transient response of circuits. Steady state response of circuits with sinusoidal excitation. Network theorems. Topology and loop and nodal analysis of general circuits. Complex frequency analysis of circuits. Response of circuits to variable-frequency excitation. Analysis of polyphase circuits. Magnetically coupled circuits.

716. Electric Circuits Laboratory.
Course 5, II Year; 3 hrs. laboratory alternate weeks, both terms.
Laboratory exercises to accompany subject 715.
Ten laboratory reports.

717. Alternating-Current Circuits. W. Janischewskyj, I. McCausland.
Courses 1 and 2, II Year; 2 hrs. lectures per week, first term.
Courses 3 and 4, II Year; 2 hrs. lectures per week, second term.
Fundamentals of alternating current, voltage and power. The analysis of series, parallel and three-phase circuits containing resistance, inductance and capacitance.

718. Alternating-Current Circuit Laboratory.
Courses 1 and 2, II Year; 3 hrs. laboratory alternate weeks, first term.
Courses 3 and 4, II Year; 3 hrs. laboratory alternate weeks, second term.
Laboratory exercises to accompany subject 717.

719. Electrical Engineering. F. A. Mason.
Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.
Basic d.c. measurements. Principles of single-phase and three-phase alternating currents. Elementary transients. Basic a.c. measurements. Principles of operation of d.c. and a.c. machines. Introduction to electronics.
Text book: Basic Electrical Engineering—Fitzgerald and Higginbotham.

720. Electrical Laboratory.
Courses 6 and 8, II Year; 3 hrs. laboratory per week, both terms.
Laboratory experiments to accompany subject 719.
Ten laboratory reports.

721. Applied Physics. J. R. Bird.
Course 1, II Year; 2 hrs. lectures per week, first term.
Course 7, II Year; 2 hrs. lectures per week, second term.
Correlating the physical principles of light, sound, and vibration with problems in engineering, emphasizing the importance of the analytical approach.

722. Applied Physics Laboratory.
Course 1, II Year; 3 hrs. laboratory per week, first term.
Course 7, II Year; 3 hrs. laboratory per week, second term.
Supplementing subject 721.
Two laboratory reports per term.

723. Optics. L. M. Steinberg.
Courses 8 and 9, II Year; 1 hr. lecture per week, both terms.
Light, geometrical and physical optics and optical instruments, photography and photomicrography.
Reference book: A Second Course in Light—A. E. E. McKenzie.

724. Optics Laboratory.

Courses 8 and 9, II Year; 3 hrs. laboratory per week, both terms.

A laboratory course supplementing subject 723.

Two laboratory reports per term.

732. Applied Mathematics. P. P. Biringer.

Course 7, III Year; 2 hrs. lectures per week, both terms; 2 hrs. computation per week, both terms.

Vector analysis; functions of a complex variable, with applications; numerical analysis.

733. Electric Circuits II. V. G. Smith.

Course 7, III Year; 3 hrs. lectures per week, both terms.

Loop and nodal equations and methods of solution. Matrix notation. General theorems. Input and transfer admittances and impedances and dimensionless transfer functions. Symmetrical component analysis. Fourier series and integrals. Fourier and Laplace transforms, direct and inverse. Operational methods applied to transients in linear systems. Dependent sources. Two-port networks. Electrical filters.

734. Electric Machinery I. A. Straughen.

Course 7, III Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Processes for the electro-mechanical conversion of energy. The fields, forces and torques in singly and multiply-excited magnetic systems. Theory, characteristics and applications of direct-current machines. Introduction to the dynamic behaviour and control of machines. Theory and applications of transformers. Introduction to rotating magnetic fields.

Reference books: Electric Machinery—Fitzgerald and Kingsley. Principles of Direct-Current Machines—Langsdorf. Direct-Current Machinery—Kloeffler, Brenneman, and Kerchner.

735. Electrical Laboratory.

Course 7, III Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises to accompany subjects 733 and 734.

736. Electrical Problems and Seminar.

Course 7, III Year; 4 hrs. per week, both terms.

Problems associated with courses 733, 734 and 737 are worked out under staff supervision. To provide practice in public speaking, one hour per week in the second term is devoted to short talks and discussions by the students on topics of their own choice.

737. Electronics. J. E. Reid.

Course 7, III Year; 2 hrs. lectures per week, first term; 3 hrs. lectures per week, second term.

The behaviour of charged particles in electromagnetic fields. Electrical conduction in solids and gases. Electron emission. Semiconductor and vacuum devices. Electronic circuits.

738. Electronics Laboratory.
Courses 5e, 5m, 5p and 7, III Year; 3 hrs. laboratory per week, second term.
Laboratory experiments to accompany subjects 737 and 739.
Five laboratory reports.

739. Electronics. E. S. Lee.
Course 5 e, m, p, III Year; 2 hrs. lectures per week, both terms.
Introduction to electrodynamics and electrical conduction in solids and gases. Physical principles of electron devices. Linear and non-linear circuits using electron devices.

740. Electronics. I. R. Dalton.
Course 5, a, c, g, n, t, III Year; 2 hrs. lectures per week, both terms.
Physical principles of electronic devices and their applications in linear and non-linear circuits. Simple instrumentation and control systems.

741. Electronics Laboratory.
Courses 5a, 5c, 5g, 5n, 5t, III Year; 1½ hrs. laboratory per week, second term. Laboratory experiments to accompany subject 740.
Five laboratory reports.

742. Circuit Analysis. J. L. Yen.
Course 5e, III Year; 2 hrs. lectures per week, both terms.
Advanced analytical methods are used to derive general network theorems and to discuss general network properties. Complex wave forms, filters and unbalanced polyphase networks are considered in detail.

743. Electronics. P. E. Burke.
Courses 3 and 4, III Year; Course 1B, IV Year; 2 hrs. lectures per week, first term.
Properties of vacuum tubes, gas tubes and semiconductors and their use as rectifiers and modulating devices. The use of circuit models containing ideal diodes and ideal controlled sources in analysing rectifiers and modulating devices.

744. Electronics Laboratory.
Courses 3 and 4, III Year; Course 1B, IV Year; 3 hrs. laboratory alternate weeks, first term.
Laboratory exercise to accompany subject 743.
Four laboratory reports.

745. Electric Machines. P. P. Biringer.
Course 5e, IV Year; 2 hrs. lectures per week, both terms.
Theory and applications of transformers, direct-current and alternating-current machines. Non-linear power modulators.

746. Electric Machines Laboratory.
Course 5e, IV Year; 3 hrs. laboratory alternate weeks, both terms.
Laboratory experiments to accompany subject 745.

747. Electric Machines. F. A. Mason.
Course 3, III Year; 2 hrs. lectures per week, both terms.
Operating characteristics, control, and applications of direct-current and alternating-current machines.

748. Electric Machines Laboratory.
Course 3, III Year; 3 hrs. laboratory alternate weeks, first term; 3 hrs. laboratory per week, second term.
Laboratory exercises to accompany subject 747.
Seven laboratory reports.

760. Electric Machines. W. Janischewskyj.
Course 4, IV Year; 2 hrs. lectures per week, first term.
Operating characteristics and applications of transformers and rotating electric machines.

761. Electric Machines Laboratory.
Course 4, IV Year; 3 hrs. laboratory per week, first term.
Laboratory exercises to accompany subject 760.
Four laboratory reports.

762. Electromagnetic Engineering. G. Sinclair.
Course 7, IV Year; 2 hrs. lectures per week, both terms; 2 hrs. computation alternate weeks, both terms.
Maxwell's equations, wave equations, retarded potentials, reciprocity theorem, lumped and distributed circuits, transmission lines under transient and steady-state conditions, impedance charts, matching, waves in rectangular and circular waveguides, radiation from linear antennas, arrays, Friis transmission formula.

763. Electric Machinery II. G. F. Tracy.
Course 7, IV Year; 3 hrs. lectures per week, first term.
The theory and performance of generators, synchronous motors, single and polyphase induction motors.
Reference books: Principles of Alternating Current Machinery—Lawrence. Alternating Current Machines—Puchstein and Lloyd. Electrical Machinery—Fitzgerald and Kingsley.

764. Electric Machines Laboratory.
Course 7, IV Year; 3 hrs. laboratory per week, first term.
Laboratory exercises to accompany subject 763.
Four laboratory reports.

765. Control Systems. J. M. Ham.
Course 7, IV Year; 2 hrs. lectures per week, both terms.
A study of the analysis and synthesis of linear feedback control systems by means of differential equations and the Laplace trans-

form. Topics covered include stability criteria, root-locus methods and compensation methods. An introductory study of non-linear systems is also made, including the use of describing-function and phase-plane methods of analysis.

766. Control Systems. J. M. Ham.

Courses 5e and 5n, IV Year; 2 hrs. lectures per week, both terms.

A course in linear and non-linear control systems that is similar to subject 765 but adapted to the needs of Courses 5e and 5n.

767. Control Systems Laboratory.

Course 5e, 5n and 7, IV Year; 3 hrs. laboratory alternate weeks, both terms.

Laboratory experiments and design problem periods to accompany subjects 765 and 766.

Four laboratory reports.

768. Electronic Circuits. J. E. Reid.

Courses 5e, 5m, 5p and 7, IV Year; 3 hrs. lectures per week, first term.

The basic principles of amplification, detection, modulation, demodulation, and radio-frequency power generation.

Reference book: Applied Electronics—Gray.

769. Electronic Circuits Laboratory.

Courses 5e, 5m, 5p and 7, IV Year; 3 hrs. laboratory per week, first term.

Experiments and problems to accompany subject 768.

Six laboratory reports.

770. Communication Systems. J. E. Reid.

Courses 5e and 7, IV Year; 3 hrs. lectures per week, second term.

A continuation of subject 768 covering theory and design of Class B and C amplifiers, power oscillators, crystal oscillators. Noise in communication circuits. Frequency conversion. Impedance transformation.

Reference book: Applied Electronics—Gray.

771. Communications Laboratory.

Courses 5e and 7, IV Year; 3 hrs. laboratory per week, second term.

Experiments and problems to accompany subject 770.

Seven laboratory reports.

772. Operational Methods. V. G. Smith.

Courses 5e, 5m, 5n, 5p and 5t, IV Year; 2 hrs. lectures per week, both terms.

Classical and Heaviside's operational methods are developed. Fourier's methods leading to the Laplace transforms are dis-

cussed and the close relationship between Laplace and Heaviside emphasized. Applications are chiefly to electric circuit analysis.

Reference books: Transformation Calculus and Electric Transients—Goldman. Electromagnetic Theory—Heaviside. Transients in Linear Systems—Gardner and Barnes. Simple Calculation of Electrical Transients—Carter.

773. Applied Electromagnetic Theory. G. Sinclair.

Courses 5e, 5g, 5n and 5p, IV Year; 2 hrs. lectures per week, both terms.

Electrostatics is reviewed and developed further to compute the capacities of engineering structures. Electromagnetism is reviewed and Maxwell's equations obtained. These are then applied in a study of plane waves, wave guides and antenna radiation.

774. Electric Machinery III. G. F. Tracy.

Course 7, IV Year; 2 hrs. lectures per week, second term.

A continuation of subject 763. Special types of alternating current motors, synchronous converters, single-phase induction motors, frequency changes, selsyn devices.

775. Electric Machines Laboratory.

Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 774.

Three laboratory reports.

776. Microwave Engineering. J. L. Yen.

Courses 5e and 7, IV Year; 2 hrs. lectures per week, second term.

The generation, processing, transmission and detection of microwaves and their applications.

777. Microwave Engineering Laboratory.

Courses 5e and 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Laboratory exercises to accompany subject 776.

779. Electric Power Systems. W. Janischewskyj.

Course 7, IV Year; 3 hrs. lectures per week, second term.

The theory associated with the economic generation, transmission and distribution of electrical energy in bulk and the control of power systems under normal and fault conditions.

780. Electric Power Systems Laboratory.

Course 7, IV Year; 3 hrs. laboratory exercises and problems per week, second term, to accompany subject 779.

781. Computer Logic and Design.

Course 7, IV Year; 1 hr. lecture per week, both terms.

An introduction to the logical structure and electronic circuits of digital computers.

790. Acoustics. V. L. Henderson.

Course 5e, IV Year; 1 hr. lecture per week, both terms.

Acoustics of electrical sound systems; including sound waves hearing, the mechanical-electrical-acoustical analogy, microphones, loud speakers, etc.

Reference book: Elements of Acoustical Engineering—Olson.

791. Acoustics Laboratory.

Course 5e, IV Year; 1½ hrs. laboratory per week, second term.

Supplementary subject 790.

792. Acoustics. V. L. Henderson.

Course 7, IV Year; 2 hrs. lectures per week, second term.

This subject deals with the properties of acoustical elements, particularly with their application in electrical sound systems.

Reference book: Elements of Acoustical Engineering—Olson.

793. Acoustics Laboratory.

Course 7, IV Year; 3 hrs. laboratory alternate weeks, second term.

Supplementing subject 792.

Three laboratory reports.

794. Illumination. Miss M. G. Currie, J. Chisvin.

Course 7, IV Year; 2 hrs. lectures per week, second term.

Illuminating Engineering dealing with the nature, measurement, and production of light and related radiations.

Theory of human vision; the design and application of lighting equipment for visual efficiency and comfort. Fundamentals of power supply.

795. Illumination Laboratory.

Course 7, IV Year; 3 hrs. alternate weeks, second term.

Supplementing subject 794.

Three laboratory reports.

798. Vibration Engineering. V. L. Henderson.

Course 5t, IV Year; 1 hr. lecture per week, both terms.

Vibrating systems with one degree of freedom. Electrical analogues and impedance methods. Systems with more than one degree of freedom. Application to machines and structures. Instrumental methods.

799. Vibration Laboratory.

Course 5t, IV Year; 3 hrs. laboratory per week, second term.

A series of experiments designed to give familiarity with the nature of vibrating systems and the causes, measurements, and control of vibration in engineering problems.

Three laboratory reports.

DEPARTMENT OF METALLURGY AND MATERIALS SCIENCE

801. Materials Processing I. L. M. Pidgeon, H. U. Ross.

Course 8, II Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

High temperature systems, furnaces, fuels, refractories and pyrometry.

802. Chemistry of Metals. L. M. Pidgeon.

Course 8, III Year; 2 hrs. lectures per week, both terms.

A fundamental treatment of the metallurgical processes involved in the production of the important non-ferrous metals, including oxidation of sulphides in the liquid and solid states, reduction of oxides, matte-slag equilibrium, metal-slag equilibrium, and the distillation of metals.

803. Chemistry of Metals Laboratory. H. U. Ross.

Course 8, III Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.

Experiments in materials processing, including roasting, smelting, leaching, refining, electrolysis to accompany Subjects 802 and 833. Eight laboratory reports per term.

804. Metallurgy. H. U. Ross.

Courses 2 and 9, III Year; 1 hr. lecture per week, second term.

An introductory course describing the theory and practice of metallurgical processes and operations.

805. Chemistry of Metals. L. M. Pidgeon, H. U. Ross.

Course 8, IV Year, 5m, IV Year; 2 hrs. lectures per week, both terms.

The extractive metallurgy of iron, steel, and the reactive metals.

806. Chemistry of Metals Laboratory. H. U. Ross.

Course 8, IV Year; 3 hrs. laboratory per week, both terms.

Experiments in the extraction and refining of metals and related processes to accompany Subject 805. Six laboratory reports per term.

808. Metallurgy. L. M. Pidgeon.

Courses 2 and 9, IV Year; 1 hr. lecture per week, both terms.

The extractive metallurgy of the common metals, together with the calculations necessary to understand metallurgical processes.

809. Metallurgy Laboratory. H. U. Ross.

Course 2, IV Year; 6 hrs. continuous laboratory per week for one half of second term.

Similar to subject 803.

One laboratory report per week.

810. Thermodynamics in Metallurgy. S. N. Flengas.
Course 8, III Year; 2 hrs. lectures per week, both terms.
The physico-chemical principles of metallurgy, properties of matter in the condensed states.

811. Materials Processing Laboratory. H. U. Ross.
Course 8, II Year; 3 hrs. laboratory per week, second term. Experiments and problems in pyrometry, furnaces, refractories, fuels and instruments to accompany Subject 801. Eight laboratory reports for the term.

812. Metallurgical Problems Laboratory. S. N. Flengas, H. U. Ross.
Course 8, III Year; 4 hrs. laboratory per week, both terms.
Problems in chemistry, physical chemistry and thermodynamics as applied to metallurgical processes, and solid state reactions relating to Subjects 802 and 810.

813. Thermodynamics in Metallurgy. S. N. Flengas.
Course 8, IV Year; 2 hrs. lectures per week, both terms.
A study of chemical equilibria at high temperatures in extractive metallurgy. Slag-metal reactions—phase diagrams. Quasichemical approach to the theory of solutions—corrosion.

814. Metallurgical Problems Laboratory. S. N. Flengas.
Course 8, IV Year; 2 hrs. lectures per week, both terms.
Problems relating to subjects 805, 807 and 813.

815. Physical Metallurgy. G. B. Craig.
Course 1, II Year; Course 2, IV Year; 2 hrs. lectures per week, second term.
A course on the structure and mechanical properties of metals and alloys and on the influence of heat and mechanical treatment upon these properties. Reference is made particularly to steels and the more-important non-ferrous alloys. Welding of metals is also included.

816. Physics of Metals. A. Plumtree.
Course 5a, III Year, Course 5c, IV Year; 1 hr. lecture per week both terms.
A course on the physics of metals to include the structure of solids, defects in the solid state, diffusion, the effects of stress and temperature upon metals, and the relationship between structure and properties.

817. Physical Metallurgy. W. C. Winegard.
Courses 3 and 4, II Year; 2 hrs. lectures per week, both terms.
A general course in Physical Metallurgy, dealing with the structure of metals and alloys, with special reference to the ferrous alloys of practical importance. The influence of mechanical deformation, heat treatment, and composition on the structure is considered, and the relation between the structure and mechanical properties is examined.

818. Physical Metallurgy Laboratory. W. C. Winegard.

Courses 3 and 4, II Year; 3 hrs. laboratory per week for six weeks, second term.

A practical course illustrating the principles dealt with in subject 817. Experiments are conducted on the heat-treatment of ferrous and non-ferrous alloys.

819. Physics of Metals. A. Plumtree.

Courses 5e and 7, III Year; 2 hrs. lectures per week, second term.

A course on the physics of metals to include structure of solids, defect structures, diffusion, electron theory, phase transformations, and the effect of stress and temperature upon metals.

820. Physics of Metals Laboratory. A. Plumtree.

Course 7, III Year; 1½ hrs. laboratory per week, second term.

Experiments are conducted to illustrate the essential features of Subject 819. These include the examination of metals by metallographic and x-ray diffraction techniques.

821. Physics of Metals. G. B. Craig and W. C. Winegard.

Courses 5m, 8, III Year; 2 hrs. lectures per week, both terms.

A discussion of the structure of solids with particular reference to x-ray methods of investigation; the solidification of metals, and the plastic deformation of metals with reference to the dislocation theory.

822. Physics of Metals Laboratory. W. C. Winegard.

Courses 5m and 8, III Year; 6 hrs. laboratory per week, first term; 3 hrs. laboratory per week, second term.

Practical work relating to Subject 821.

823. Physics of Metals. G. B. Craig and W. C. Winegard.

Courses 5m and 8, IV Year; 2 hrs. lectures per week, both terms.

Transformations which occur in alloys, diffusion, electron theory, surface reactions.

824. Physics of Metals Laboratory. G. B. Craig.

Courses 5m and 8, IV Year; 3 hrs. laboratory per week, both terms; 3 hrs. laboratory per week, second term.

Practical work relating to Subject 823.

826. Chemistry and Physics of Materials Seminar. Staff in Metallurgy.

Courses 5m and 8, IV Year; 3 hrs. laboratory per week, both terms.

Each student prepares and presents seminars on topics concerning chemistry and physics of materials.

827. Chemistry and Physics of Materials Laboratory. Staff in Metallurgy.

Course 5m, IV Year; 12 hrs. per week, first term; 9 hrs. per week, second term (1964–65 only).

The design and execution of one or more experiments on a

topic of current interest in the field of chemistry and physics of materials.

828. Chemistry of metals. L. M. Pidgeon.
Course 5m, III Year; 1 lecture per week, both terms.
A discussion of the production and properties of the metals commonly used in Engineering.

829. Chemistry of Metals Laboratory. H. U. Ross.
Course 5m, III Year; 4 hrs. per week, second term.
Experiments designed to illustrate the principles underlying the high temperature reactions which are encountered in the production and refining of metals.

830. Metallurgical Thermodynamics. S. N. Flengas.
Course 5m, III Year; 1 lecture per week, both terms.
Chemical equilibria at high temperatures in extractive metallurgy. Condensed states of matter—quasichemical approach to the theory of solutions—slag theories—metallic solutions—slag/metal equilibria—kinetics of metallurgical processes.

831. Metallurgical Thermodynamics Problems. S. N. Flengas.
Course 5m, III Year; 2 hrs. per week, both terms.
Problems relating to Subject 830.

832. Physics and Chemistry of Materials. Staff in Chemical Engineering, Civil Engineering, Electrical Engineering and Materials Science.
Courses 5m, 8, III Year; 2 hrs. lectures per week, both terms.
A course on the structure and properties of plastics, glass, ceramics, semi-conductors, and concrete.

833. Materials Processing II. H. U. Ross.
Course 8, III Year; 1 hr. lecture per week, both terms.
The theory and practice of processing metallic and non-metallic materials, including the relevant aspects of mineralogy, surface chemistry, physical separation, calcining, roasting, sintering and leaching.

INSTITUTE FOR AEROSPACE STUDIES

1030. Advanced Mechanics. H. S. Ribner.
Course 5, III Year; 2 hrs. lectures per week, both terms.
Mechanics of particles: fixed axes, rotating and moving axes, orbital dynamics, rockets. Mechanics of rigid bodies: fixed axes, body-attached axes, gyroscopes. Mechanics of linear systems: free and forced oscillations, coupled systems, waves on a string, Rayleigh's method. Lagrange's equations. Introduction to special relativity.
Reference books: Introduction to Theoretical Physics—Page. Principles of Mechanics—Synge and Griffith.

1032. Fluid Mechanics. D. E. Rothe, W. D. Baines.

Courses 5a, 5c, 5n, 5t, III Year; 2 hrs. lectures per week, both terms.

Introductory concepts; vector analysis; inviscid flow, incompressible and compressible; viscous flow and turbulence; similitude and models; conduit systems; gravity effects; fluid machinery.

1033. Fluid Mechanics Laboratory. D. E. Rothe, B. Etkin, J. B. French, W. D. Baines.

Courses 5a, 5c, 5n, 5t, III Year; 3 hrs. laboratory per week, both terms.

Problems and experiments related to subject 1032.

Ten laboratory reports.

1034. Mechanics of Solids and Structures. R. C. Tennyson.

Course 5a, III Year; 2 hrs. lectures per week, both terms.

A discussion of the structure of solids and the mechanics of their deformation. An introduction to the classical theories of elasticity and plasticity with application to the analysis of simple structures.

Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

1035. Mechanics of Solids and Structures Laboratory. R. C. Tennyson.

Course 5a, III Year; 3 hrs. laboratory per week, both terms.

Problems and experiments related to subject 1034.

Four laboratory reports.

1040. Aerodynamics. B. Etkin.

Course 5a, IV Year; 2 hrs. lectures per week, both terms.

Aerodynamics of flight: drag, propulsion, wing theory. Mechanics of flight: Performance of aircraft, stability and control of aircraft.

Reference books: Aerodynamics for Engineering Students—Houghton and Brock. Foundations of Aerodynamics—Kuethe and Schetzer. Flight Mechanics—1: Theory of Flight Paths—A. Miele. Dynamics of Flight—Stability and Control—Etkin.

1041. Aerodynamics Laboratory. B. Etkin.

Course 5a, IV Year; 3 hrs. laboratory per week, second term.

Problems and experiments related to subject 1040.

Five laboratory reports.

1042. Engineering Design. R. D. Hiscocks.

Course 5a, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

An introduction to the principles of design; the origin of a design requirement; loading, performance and other criteria; typical design specifications.

The process is examined by which the design is synthesized from the design specification and various other related data.

Selection of material; type of structure and fabrication technique.

Certain important aspects of design are examined in detail. These include the design of riveted, bolted, glued and welded joints, the design of cast and forged structural components, the fatigue life of structures and "fail safe" principles.

The course is illustrated throughout by reference to typical design problems, some of which are solved by the students.

1043. Engineering Design Laboratory. R. D. Hiscocks.

Course 5a, IV Year; 3 hrs. laboratory per week, both terms.

Design projects based on the lectures in subject 1042 are assigned. Design drawings, and engineering reports are prepared by the students.

1044. Mechanics of Solids and Structures. R. C. Tennyson.

Course 5a, IV Year; 1 hr. lecture per week, both terms.

A continuation of subject 1034 to a more advanced level; structural stability; thermal stresses; structural vibrations and wave propagation.

Reference books: Elasticity in Engineering—Sechler. Inelastic Behaviour of Engineering Materials and Structures—Freudenthal.

1045. Mechanics of Solids and Structures Laboratory. R. C. Tennyson.

Course 5a, IV Year; 3 hrs. laboratory per week, first term.

Problems and experiments related to subject 1044.

Six laboratory reports.

1046. Plasmadynamics. J. H. deLeeuw.

Course 5a, IV Year; 1 hr. lecture per week, first term; 2 hrs. lectures per week, second term.

Review of electric and magnetic fields. Derivation of Maxwell's equations. Thermodynamics and equations of motion of an electrically conductive medium. Simple examples of the influence of a magnetic field on the motion of an electrically conductive medium.

1047. Plasmadynamics Laboratory. J. H. deLeeuw, J. B. French.

Course 5a, IV Year; 3 hrs. laboratory alternate weeks, second term.

Problems and experiments based on the lecture material of subject 1046.

Two laboratory reports.

1048. Gasdynamics. A. G. Boyer.

Courses 5a and 5t, IV year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

Introductory thermodynamics of perfect and imperfect gases; equations of motion and their applications to nozzles, diffusers, shock tubes, and shock tunnels; expansion waves and normal and oblique shock waves in perfect and imperfect gases; shock and expansion wave interactions.

Reference books: Elements of Gasdynamics—Liepmann and Roshko. Dynamics and Thermodynamics of Compressible Fluid Flow—Shapiro. Handbook of Supersonic Aerodynamics, Section 18, Shock Tubes—Glass and Hall.

1049. Gasdynamics Laboratory. I. I. Glass, J. B. French, A. G. Boyer.

Courses 5a and 5t, IV Year; 3 hrs. laboratory alternate weeks, first term; 3 hrs. laboratory per week, second term.

Problems and experiments based on subject 1048 are given to illustrate principles of gasdynamics and the measurement of physical quantities.

Six laboratory reports.

1050. Transport Phenomena. J. B. French.

Course 5a, IV Year; 1 hr. lecture per week, both terms.

A fundamental treatment of selected phenomena in fluid dynamics in which the transport of momentum, mass and energy are the key underlying processes, i.e. dynamics of viscous fluids; boundary layers; diffusion.

Reference book: Transport Phenomena—Bird, Stewart and Lightfoot.

DEPARTMENT OF PHILOSOPHY

2040. Philosophy of Science. Marcus Long, C. W. Webb.

Courses 1, 2, 3, 4, 5, 6, 7, 8, and 9, IV Year; 2 hrs. lectures per week, first term.

The relation between Science and Philosophy; an examination of the presuppositions of science and its basic concepts; alternative accounts of the nature of the universe with their implications for social and moral behaviour.

DEPARTMENT OF ENGLISH

2110. English.

All courses, I Year; 2 hrs. lectures per week, both terms.

A course in essay writing and the reading of literary works. Texts will include: Robertson, *Errors in Composition* (Macmillan), Altick, *Preface to Critical Reading* (Holt, Rinehart), Kazin, *The Open Form* (Harcourt Brace); Swift, *Gulliver's Travels* (Modern Library College), Orwell, *Animal Farm* (Penguin), Waugh, *The Loved Ones* (Dell); Shakespeare, *As You Like It* (Folger), Goldsmith, *She Stoops to Conquer* (Crofts Classics), Synge, *Playboy of the Western World* (Vintage); an anthology of poetry to be announced in September.

2140. English Literature.

All courses, IV Year; 1 hr. lecture per week, both terms.

A course in the drama, the novel and poetry based on the study of the following texts: Shakespeare, *Othello* (Folger), Tennessee

Williams, *Streetcar Named Desire* (Signet), O'Casey, *Juno and the Paycock* in *Three Plays* (St. Martin's Library), Wilde, *Importance of Being Earnest* in *Five Plays* (Bantam); Fielding, *Joseph Andrews* (Holt, Rinehart), Woolf, *To the Lighthouse* (Harbrace Modern Classics), Cary, *Horse's Mouth* (Universal Library); Oscar Williams, *Little Book of Modern Verse* (Scribners).

Students are expected to read the works named above during the summer preceding their entry into the Fourth Year. Term work will include assignments based on texts read during the summer, one substantial essay, and two class tests. Students who obtain a satisfactory term mark will not be required to write a final examination.

DEPARTMENT OF HISTORY

2330. Europe and the Modern World, 1500–1950. J. Estes.

All courses, III Year (elective); 2 hrs. lectures per week, both terms.

An introduction to the main currents of European history between 1500 and 1950, and of European relations with the extra-European world. The purpose of the course is not merely the accumulation of factual information, but also the attainment of some understanding of historical processes affecting the forms of political organization, economic activity, intellectual and social movements.

DEPARTMENT OF MATHEMATICS

2410. Calculus, Analytical Geometry and Algebra. R. A. Adams, C. Billigheimer, R. R. Burnside, T. M. K. Davison, W. N. Selander, S. H. Smith, P. Tan, J. R. Vanstone.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 3 hrs. lectures per week, both terms.

Real numbers and functions; limits, continuity and derivative functions; basic formulae of the differential calculus involving algebraic, trigonometric and exponential functions; applications to the sketching of curves, linear motion and rate problems. The definite integral and the fundamental theorem of the integral calculus, applied to the calculation of areas, volumes and work; techniques of integration, change of variable, integration by parts. Euclidean geometry in two and three dimensions; linear algebra, vector spaces, scalar products, matrices and determinants; eigenvalues and the reduction of the equations of quadric surfaces to standard forms.

2415. Algebra and Geometry. D. A. Clarke, Miss M. Wonenburger.

Course 5, I Year; 2 hrs. lectures per week, both terms.

Complex numbers and fields. Polynomials. Linear Algebra:

linear equations, vector spaces and linear transformations. Coordinate Geometry: lines, planes and surfaces of the second degree.

2416. Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, I Year; 2 hrs. lectures per week, both terms.

An introduction to the theory and applications of differential and integral calculus.

Reference books: Calculus—Sherwood and Taylor. Calculus, Vol. I—Apostol.

2420. Calculus. B. Brainerd, P. B. Chapman, G. Tanyi, W. H. Williams.

Courses 1, 2, 3, 4, 6, 8, and 9, II Year; 2 hrs. lectures per week, both terms.

Continuation of subject 2410. Partial differentiation, multiple integration, series and Taylor's theorem, complex numbers and hyperbolic functions, first order differential equations and higher order linear differential equations with constant coefficients. Problems dealt with in the drafting room as outlined in subjects 138, 143, 144 and 383.

2421. Calculus and Differential Equations. D. R. Breach.

Course 7, II Year; 2 hrs. lectures per week, both terms. 2 hrs. computation per week, both terms.

The definite integral, expansion in series, ordinary differential equations, partial differentiation, multiple integration and an introduction to partial differential equations.

2423. Probability and Statistics. W. R. Knight.

Courses 4 and 8, II Year; 2 hrs. lectures per week, both terms.

Frequency distributions and probability laws; binomial, Poisson, and normal distributions and the treatment of samples drawn from them; tests of significance and confidence limits; control charts; introduction to the analysis of variance; design of experiments; regression theory.

2424. Probability and Statistics Laboratory. W. R. Knight.

Courses 4 and 8, II Year; 3 hrs. laboratory per week, both terms.

Laboratory exercises associated with the material of the companion lecture subjects.

2425. Differential Calculus. W. J. R. Crosby, D. K. Sen.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Ordinary and partial differentiation, differentials, Taylor's theorem for functions of one or more variables, maxima and minima, transformations, convergence and uniform convergence, differential equations of the first order, linear differential equations with constant coefficients.

Reference books: Advanced Calculus—Sokolnikoff. Advanced Calculus—Taylor.

2426. Integral Calculus. W. J. Webber, K. B. Ranger.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Methods of indefinite integration, definite integrals, multiple integrals, line and surface integrals, orthogonal functions.

Text book: Advanced Calculus—Sokolnikoff.

2427. Probability and Statistics. W. R. Knight.

Course 5, II Year; 2 hrs. lectures per week, both terms.

Definition of probability; binomial, Poisson, and normal distributions; frequency; sampling distributions. Examples of estimation, hypothesis testing, control charts, regression, and analysis of variance.

2428. Mathematical Problems. W. J. R. Crosby, W. R. Knight, K. B. Ranger, D. K. Sen, W. J. Webber.

Course 5, II Year; 3 hrs. problems per week, both terms.

A laboratory course: uses weekly problems based on the content of courses 2425, 2426, 2427 and provides an opportunity for informal discussion of topics presented in these courses. A portion of the time will be devoted to machine calculation.

2432. Differential Equations. C. Davis, W. P. Kotorynski.

Courses 3, 4, and 8, III Year; 2 hrs. lectures per week, both terms.

First and second order ordinary differential equations, operational methods, variation of parameters, solution in series, Fourier series, Bessel and Legendre functions, the Laplace transform.

2433. Numerical Analysis. W. R. Knight.

Course 4, III Year; 2 hrs. lectures per week, both terms.

Vectors, matrices, inversion of matrices, regression theory and calculations, elements of the design of experiments, theory of sampling.

2434. Numerical Analysis Laboratory. W. R. Knight.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Practice in the numerical analysis methods and techniques dealt with in the lecture subject. Practical problems, as well as problems of a fundamental mathematical nature, will be covered.

2437. Theory of Functions. W. H. Greub.

Courses 5a, 5e, 5g, 5m, 5n, 5p, 5t, III Year; 2 hrs. lectures per week, both terms.

Complex numbers, limits and series, analytic functions, Cauchy's theorem, Taylor and Laurent series, singularities and their significance, analytic continuation, contour integration, conformal mapping of one plane region on another.

Text books: Functions of a Complex Variable—Phillips. Theory of Functions—Copson. Theory of Functions as Applied to Engineering Problems—Rothe, Ollendorf, and Pohlhausen. Introduction to Complex Variables and Applications—Churchill.

2438. Differential Equations. S. H. Smith.

Course 5, III Year; 2 hrs. lectures per week, both terms.

First order equations solvable by quadratures, the linear equation of general order, operator methods, simultaneous linear equations, Sturn-Liouville systems.

Text book: Ordinary Differential Equations—Kaplan.

2442. Statistics. P. Tan.

Course 8, IV Year; 2 hrs. lectures per week, second term.

An introduction to the statistical methods used in the analysis and control of production processes.

2445. Differential Equations of Mathematical Physics. G. F. D. Duff.

Courses 5a, 5e, 5g, 5m, 5n, 5p, 5t, IV Year; 2 hrs. lectures per week, both terms.

The underlying theory and important particular equations, including eigenvalues and eigenfunctions, Fourier integrals, spherical and cylindrical harmonics, vibration of strings, membranes, and rods, sound waves, equation of heat conduction.

Text book: Partial Differential Equations of Mathematical Physics—Webster.

DEPARTMENT OF PHYSICS

2501. The Structure and Properties of Matter. J. N. P. Hume, A. Danielian, A. D. May, J. D. Poll, R. E. Pugh.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year; 2 hrs. lectures per week, both terms.

An introduction to the mechanical, electrical, magnetic, thermal and optical properties of matter in terms of atoms.

2502. Physics Laboratory. The Staff in Physics, Civil Engineering and Electrical Engineering.

Courses 1, 2, 3, 4, 6, 7, 8 and 9, I Year;

Twenty-four 3-hour periods of laboratory or problem work, twelve of which are devoted to experiments in the Physics Laboratory, six to experiments in the Electrical Laboratory and six to problems in Applied Mechanics.

All work must be completed within the assigned laboratory hours.

2511. Properties of Matter, Mechanics and Heat. D. G. Ivey.

Course 5, I Year; 3 hrs. lectures per week, both terms.

Text book: Mechanics, Heat and Sound—Sear.

2512. Physics Laboratory. D. G. Ivey and the staff in Physics.

Course 5, I Year; 3 hrs. laboratory per week, both terms; 1 hr. tutorial per week, both terms.

To accompany subject 2511.

2521. Physics. J. N. P. Hume.
Course 5, II Year; 3 hrs. lectures per week, both terms.
Fundamental theory of electricity and magnetism. Acoustic and electromagnetic waves. Interference, diffraction and polarization of light waves. Elementary atomic physics.

2522. Physics Laboratory. J. N. P. Hume.
Course 5, II Year; 3 hrs. laboratory per week, both terms.
To accompany subject 2621.

2525. The Physical Principles of Heat and Optics. R. Richmond.
Course 8, II Year; 2 hrs. lectures and 3 hrs. laboratory per week, first term.
Thermal expansion, capacity, conductivity; radiation laws. Reflection, refraction, dispersion. Lens systems and optical instruments. Polarising and phase microscopes, interference, diffraction, coherence, optical masers.
Text books: Heat and Sound—Sears, Optics—Sears.

2531. Thermodynamics and Statistical Physics. J. C. Stryland.
Courses 5a, 5e, 5g, 5n, 5p, 5t, III Year; 2 hrs. lectures per week, both terms.
The fundamental principles of thermodynamics, kinetic theory and statistical mechanics.

2532. Physics Laboratory. J. C. Stryland, H. P. Gush.
Courses 5a, 5e, 5g, 5n, 5p, 5t, III Year; 3 hrs. laboratory per week, both terms.
To accompany subjects 2531, 2533 and 2534.

2533. Atomic Structure and Quantum Physics. H. P. Gush.
Courses 5e, 5n, and 5p, III Year; 2 hrs. lectures per week, both terms.
Waves and particles; Schrodinger equation; harmonic oscillator, hydrogen atom, many-electron atoms; nuclear structure; radioactivity; interaction of radiation with matter.

2534. Physics of Solids and Fluids. R. List.
Courses 5e, 5g, 5m, 5p, III Year; 1 hr. lecture per week, both terms.
Elasticity, viscosity, equations of fluid motion, wave propagation, heat conduction, potential theory.

2535. Nuclear Physics. K. G. McNeill.
Courses 5n, III Year; 1 hr. lecture per week, both terms.
Neutron physics, nuclear radiation detection techniques, introduction to reactor theory and shielding problems, health physics.

2536. Physics of the Earth. G. D. Garland.
Course 5g, III year; 2 hrs. lectures per week, both terms.
Seismology and the internal constitution of the earth; the gravitational field; the earth's magnetism and magnetic properties of rocks; radioactivity, geothermal heat and the age of the earth.

2541. Electromagnetic Radiation and Matter. H. L. Welsh.

Course 5p, IV Year; 2 hrs. lectures per week, both terms.

Propagation of electromagnetic waves, polarization, diffraction, interference, dispersion, scattering. Absorption, spontaneous and stimulated emission, Einstein coefficients. Coherence, maser and laser action.

2542. Physics Laboratory. The Staff in Physics.

Course 5n, IV Year; 6 hrs. laboratory per week, first term, and 3 hrs. per week, second term.

Courses 5c and 5p, IV Year; 6 hrs. laboratory per week, both terms.

To accompany the lecture subjects 2541, 2544, 2545 and 2546.

2543. Molecular Physics and Statistical Mechanics. E. J. Allin and J. D. Poll.

Course 5p, IV Year; 2 hrs. lectures per week both terms.

Quantum theory of rotation and vibration of molecules. Nuclear spins, symmetry, intensity rules, the hydrogen molecule, intermolecular forces. Boltzmann theory, transport equations, the Gibbs method, partition functions.

2544. Nuclear and High Energy Physics. K. G. McNeill, L. E. H. Trainor.

Courses 5n, 5p, IV Year; 2 hrs. lectures per week, both terms.

Nuclear forces, alpha-decay, beta-decay. Excited states of nuclei. Nuclear models. Reaction theory. Mesons, anti-particles, hyperons.

2545. Quantum Mechanics. J. Van Kranendonk.

Course 5p, IV Year; 2 hrs. lectures per week, both terms.

Schrodinger equation, eigenvalues and eigenfunctions. Angular momentum, Pauli spin theory, identical particles. Perturbation theory, transition probabilities. Scattering theory.

2546. Atomic Physics. Miss E. J. Allin, D. A. L. Paul.

Courses 5a, 5g, 5m and 5t, IV Year; 3 hrs. lectures per week, both terms.

Introduction to quantum theory, atomic, molecular and nuclear physics.

2561. Theory and Application of Geophysical Methods. F. S. Grant.

Course 5g, IV Year; 2 hrs. lectures per week, both terms.

A course on the mathematical theory of magnetic, electrical, seismic and gravitational methods in applied geophysics.

2562. Geophysics. F. S. Grant, G. F. West.

Course 5g, IV Year; 6 hrs. laboratory per week, both terms.

To accompany subject 2661.

2568. Exploration Geophysics. R. M. Farquhar, G. D. Garland.

Course 9, IV Year; 1 hr. lecture per week, both terms.

An introduction to the physical principles underlying the

important methods of geophysical prospecting. Particular attention is given to the seismic, gravitational, magnetic and electromagnetic methods.

Text book: Introduction to Geophysical Prospecting—Dobrin.

2569. Geophysics. R. M. Farquhar.

Course 9, IV Year; 3 hrs. laboratory per week, both terms.

To accompany subject 2668.

DEPARTMENT OF CHEMISTRY

2621. Inorganic Chemistry. E. A. Robinson.

Course 5, II Year (elective); 2 hrs. lectures per week, both terms.

General inorganic chemistry, stereochemistry, and related physical measurements. Bonding and molecular structure.

2622. Physical Chemistry. S. S. Danyluk.

Courses 6 and 8, II Year; 2 hrs. lectures per week, both terms.

An introductory course in chemical thermodynamics with emphasis on the thermodynamics of phase equilibria.

2623. Chemistry. M. J. Dignam.

Course 7, II Year; 2 hrs. lectures per week, first term.

Inorganic Chemistry, with emphasis on the fundamental particles, atomic structure, the nature of the chemical bond and general structural chemistry.

2624. Analytical Chemistry Laboratory. F. E. Beamish.

Course 8, II Year; 3 hrs. laboratory per week, both terms.

Quantitative analysis.

Eight laboratory reports.

2631. Atomic and Molecular Structure. J. P. Valleau.

Courses 5c, 5m, III Year; 2 hrs. lectures per week, both terms.

To follow course 2621. The application of wave mechanics to some problems of atomic and molecular structure, and an introduction to statistical thermodynamics.

2632. Electrochemistry. J. P. Valleau.

Courses 6 and 8, IV Year; 2 hrs. lectures per week, first term.

Principles of electrochemistry and their application to industrial problems.

2633. Electrochemistry Laboratory. J. P. Valleau, R. G. Barradas.

Courses 6 and 8, IV Year; 18 hrs. first term.

Quantitative measurements to accompany subject 2632. Six laboratory reports required.

DEPARTMENT OF POLITICAL ECONOMY

2720. Economics. D. F. Forster, B. Bixley, A. Kruger, D. Nowlan.
All courses, II Year; 2 hrs. lectures per week, both terms.
An introduction to the study of Economics with special reference to the problems of the Canadian economy.

2730. Introduction to Political Science. P. Bishop, R. Gregor.
All courses, III Year (elective); 2 hrs. lectures per week, both terms.
An introduction to the study of government with special reference to the problems of Canadian government.

2734. Accounting. W. C. Hebdon.
Course 4, III Year; 2 hrs. lectures per week, both terms.
Basic accounting principles and procedures, the preparation and interpretation of financial statements, cost accounting, and the use of accounting as a means of control.

DEPARTMENT OF PSYCHOLOGY

2840. Industrial Psychology.
Course 4, IV Year; 2 hrs. lectures per week, second term.
A series of lectures and discussions on human relations, with the focus on some of the current problems in a developing industrial culture.

DEPARTMENT OF GEOLOGICAL SCIENCES

2900. Physical Geology. P. A. Peach.
Courses 2 and 9, II Year; 2 hrs. lectures per week, first term.
Course 5g, III Year; see subject 2902.
An Introduction to the study of geology and mineralogy.
Reference books: Principles of Geology—Gilluly, Waters and Woodford *or* Physical Geology—Leet and Judson.

2901. Physical Geology Laboratory. J. Gittins.
Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. laboratory and 1 hr. tutorial per week, first term.
A laboratory course to accompany subject 2900.

2902. Physical Geology. P. A. Peach.
Course 5g, III Year.
A reading course during the summer preceding the III Year. A special examination will be held. Students who do not pass this examination will be required to write the examination in Subject 2900 in January.

2904. Geology of Canada. F. W. Beales.
Course 9, IV Year; 1 hr. lecture per week, both terms.
A reading survey of the physiography, historical geology, major structural features, and mineral deposits of the country.

2906. Engineering Geology. W. H. Gross.

Course 1, II Year; 2 hrs. lectures per week, first term; 1 hr. lecture per week, second term.

An introduction course in geology with special reference to engineering problems.

2907. Engineering Geology Laboratory.

Course 1, II Year; 1 hr. per week, first term; 2 hrs. per week, second term.

Specimens, maps and sections to accompany subject 2906.

2910. Mineralogy and Lithology. D. H. Gorman, P. A. Peach.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. lectures per week, both terms.

A study of crystallography, descriptive and determinative mineralogy, and the common rocks.

Reference book: An Introduction to the Study of Minerals—Rogers.

2911. Mineralogy and Lithology Laboratory. D. H. Gorman, P. A. Peach.

Courses 2 and 9, II Year; Course 5g, III Year; 2 hrs. per week, both terms.

Practice in identifying minerals and rocks.

2913. Descriptive Mineralogy. D. H. Gorman.

Course 9, III Year; 2 hrs. laboratory per week, both terms.

Continuation of the mineralogy of subject 2910.

2915. Ore Microscopy. D. H. Gorman.

Course 9, III Year; 3 hrs. laboratory per week, second term.

Identification of minerals in polished sections.

2916. Crystallography. E. W. Nuffield.

Courses 5m, 5p and 8, III Year; 1 hr. lecture per week, both terms.

The modern concept of crystals; symmetry elements; derivation of space lattices, classes, forms, indices.

2918. X-Ray Crystallography. E. W. Nuffield.

Course 5m, IV Year; 2 hrs. lectures per week, second term.

X-ray diffraction methods and their application in the study of crystalline materials.

2920. Petrology. P. A. Peach.

Course 9, III Year; 3 hrs. lectures per week, first term; 2 hrs. lectures per week, second term.

Microscopic petrography, classification and origin of rocks.

2921. Petrography Laboratory. P. A. Peach.

Course 9, III Year; 2 hrs. per week, both terms.

Microscopic petrography, to accompany subject 2920.

Text book: Optical Mineralogy—Rogers and Kerr.

One laboratory report.

2924\. Elementary Geochemistry. F. G. Smith.
Course 9, III Year; 2 hrs. lectures per week, both terms.
Covering the periodic table, distribution of the elements, states of matter, phase diagrams, natural hydrothermal solutions, weathering, and geochemical cycles.

2930\. Historical and Stratigraphical Geology. F. W. Beales.
Courses 2 and 9, II Year; 2 hrs. lectures and 1 hr. tutorial per week, second term.
Study of the principles of stratigraphy and historical geology since Precambrian times.

2931\. Historical and Stratigraphical Geology Laboratory. F. W. Beales.
Course 9, II Year; 2 hrs. per week, second term.
Laboratory work to illustrate subject 2930.

2932\. Stratigraphy and Sedimentation. F. W. Beales.
Course 9, III Year; 2 hrs. lectures per week, first term.
Description, classification and interpretation of sedimentary rocks and rock units.

2934\. Glacial Geology and Ground Water. R. E. Deane.
Course 2, IV Year; 1 hr. lecture per week, both terms.
Pleistocene Geology. The formation and distribution of the drift deposits of North America, with emphasis on their economic importance.

2936\. Pleistocene Geology. R. E. Deane.
Courses 1D and 9, IV Year; 2 hrs. lecture per week, both terms.
Study of the Pleistocene Deposits of North America and Europe.

2938\. Palaeontology. M. A. Fritz.
Course 9, III Year; 2 hrs. lecture per week, both terms.

2939\. Palaeontology Laboratory. M. A. Fritz.
Course 9, III Year; 2 hrs. per week, both terms.
Six laboratory reports.

2944\. Precambrian Geology. W. W. Moorhouse.
Courses 2, 5g, and 9, IV Year; 2 hrs. lecture per week, first term.
Precambrian formations of Canada—their rocks, distribution, relationships and economic features.

2945\. Precambrian Geology Laboratory. W. W. Moorhouse.
Courses 2 and 5g, IV Year; 1 hr. laboratory per week, first term.
Course 9, IV Year; 3 hrs. laboratory per week, both terms.
To accompany subject 2944.

2950\. Structural Geology. J. B. Currie.
Courses 2, 5g and 9, III Year; 1 hr. lecture per week, both terms.
Development of structures in sedimentary, igneous and metamorphic rocks of the earth's crust.
Text book: Structural Geology—Billings.

2951. Structural Geology Laboratory. J. B. Currie.
Courses 2, 5g and 9, III Year; 3 hrs. per week, both terms.
A study of methods employed in solving structural problems.
Laboratory course to accompany subject 2950.

2960. Mineral Deposits. W. H. Gross.
Courses 2, 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
Theories of origin of mineral deposits and description of world's important mineral deposits.

2961. Mineral Deposits Laboratory. W. H. Gross.
Course 9, IV Year; 3 hrs. per week, second term.

2964. Petroleum Geology. J. B. Currie.
Courses 5g and 9, IV Year; 2 hrs. lecture per week, both terms.
The occurrence of petroleum and natural gas pools and geological conditions of oil and gas entrapment in sedimentary basins.

2965. Petroleum Geology Laboratory. J. B. Currie.
Courses 5g and 9, IV Year; 3 hrs. per week, second term.
Laboratory study of methods for structural and stratigraphic analysis of oil accumulation in a sedimentary basin.

2968. Mining Geology. G. B. Langford.
Courses 2 and 9, IV Year; 2 hrs. lecture per week, second term.
A course dealing with the application of geology to mining.
Reference book: Mining Geology—McKinstry.

2969. Mining Geology Laboratory. G. B. Langford.
Course 9, IV Year; 3 hrs. per week, first term.
Two laboratory reports.

2981. Stratigraphic and Sedimentary Field Work. F. W. Beales.
Course 9, III Year; 2 hrs. per week, first term.
Field work along the Niagara Escarpment.
Three laboratory reports.

2983. Petrological, Mineralogical and Structural Field Work.
Course 2, III Year: 7 days.
Course 9, III Year: 14 days.
A field camp in the Tweed area of Ontario. Laboratory work in the field complementing subjects 2920 and 2951.

2985. Geological Field Trips (Glacial Geology).
Courses 2 and 9, IV Year. Two trips.
During the fall trips will be made to points of interest near Toronto.

2987. Geological Field Trips (Economic and Mining).
Course 9, IV Year. Two trips, each ½ day.
Trip to gypsum mine and cement plant.

SCHOOL OF BUSINESS

3030. Industrial Management. T. C. Graham.

Course 4, III Year; 2 hrs. lectures per week, both terms.

A study of the factors involved in the production and distribution of products or services. Consideration will be given to the general concepts of management, organization, leadership and industrial relations but major emphasis will be on work simplification, time and motion study, wage administration and controls of production, quality and costs.

3031. Industrial Management Laboratory. T. C. Graham.

Course 4, III Year; 3 hrs. laboratory per week, both terms.

Cases and problems to accompany the lecture subject.

DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION

3110. Physical Education.

All courses, I Year.

The University requires that each student in his or her first year at the University take a medical examination given by the University Health Service. In addition each first year student, unless exempted as provided below, must register for and satisfactorily complete a swim test and the required programme in Physical Education. Any student, unless exempted, who does not satisfactorily complete the Physical Education requirement *shall pay an additional fee of $50.00 at the beginning of the next session in which he or she is registered in the University. THIS SPECIAL FEE WILL BE REFUNDED IF THE STUDENT REGISTERS FOR AND SATISFACTORILY COMPLETES THE REQUIRED PROGRAMME IN THAT SESSION.*

Physical Education credits may be earned by participation in instructional classes, swimming and water safety classes, intercollegiate and intramural sports.

EXEMPTIONS

1. One year's satisfactory standing in Physical Education at this or any other University.
2. Admission by advanced standing to second or a higher year at this University (automatic exemption).
3. If age is 25 years or more.
4. Ex-Military service (Permanent Force).
5. Provisional acceptance by the U.N.T.D., C.O.T.C., OR U.R.T.P. followed by satisfactory completion of one year's service.
6. Exemption by the University Health Service.
7. Special consideration.

TO CLAIM EXEMPTION — Report by October 31st to:

Men —Intramural office, Room 106, Athletic Wing, Hart House.
Women—Room 230, Benson Building, 320 Huron Street.

INSTITUTE OF COMPUTER SCIENCE

3331. Engineering Data Processing. C. C. Gotlieb, J. Csima.
Courses 4 and 8, III Year; 2 hrs. lectures per week, second term.
A course in programming and coding for the digital computer.

3332. Engineering Data Processing Laboratory. C. C. Gotlieb, J. Csima.
Courses 4 and 8, III Year; 3 hrs. laboratory per week, second term.
Practical work to accompany subject 3331.

SPECIAL LECTURERS

3440. Engineering Law. W. O. Chris. Miller.
Courses 1, 3, 4, 6, and 7, IV Year; 1 hr. lecture per week, first term.
A subject designed to co-ordinate the practice of engineering and law. Consideration is given to the characteristics, advantages and disadvantages of companies, partnerships and sole proprietorships, the promotion, organization and financing of companies, the duties of employees to employers, the duties and liabilities of engineers, statutes applicable to engineering works, professional engineering associations, construction contracts, workmen's compensation, trade unions and industrial disputes.
Text book: Engineering Law—Laidlaw and Young.

SCHOOL OF ARCHITECTURE

3540. Town and Regional Planning. M. Hugo-Brunt.
Course 1B, IV Year; 1 hr. lecture per week, both terms.
Town Planning principles both past and present. The role of the planner, the plan, local legislation, the central area, the neighbourhood, subdivision, the suburb, open space and the region, housing, road layout, services, industry, commerce and special uses.

3541. Town and Regional Planning. M. Hugo-Brunt.
Course 1B, IV Year; 3 hrs. practical work per week, both terms.
Studio work including exercises in survey, research and analysis, subdivision layout, and urban analysis. These are related to subject 219.

SECTION IX. EXAMINATIONS

ANNUAL EXAMINATIONS

1. Annual examinations will be held in April except as provided in paragraph 2 below.

2. Annual examinations will be held at the beginning of the second term in subjects completed during the first term.

3. Promotion from one year to another is made on the basis of the student's weighted average in the annual examinations and laboratory and other term work. Subjects will be weighted according to the number of hours devoted to them, the hours assigned to laboratory subjects being given one half the weight of those in lecture subjects.

Pass standing and promotion to the next higher year will be granted to students who obtain a weighted average of 60% or greater in the work of the year.

4. The student's work is graded in the following manner:

On Overall Average		*On Individual Subjects*	
Marks	Standing	Marks	Grade
75 — 100%	I Class (Honours)	75 — 100%	I
66 — 74%	II Class	66 — 74%	II
60 — 65%	III Class	60 — 65%	III
Below 60%	Failure	50 — 59%	Pass
		Below 50%	Failure or BL

5. A student who obtains the passing average of 60% or greater in the work of the year but who has failed to pass one or more subjects will receive a standing of BL (below the line) in such subjects, and will be promoted to the next higher year.

6. Honour standing will be granted to students who pass in all written and laboratory subjects and who obtain a weighted average of 75% or greater in the work of the year.

7. Honour graduate standing will be granted to students who obtain honours in the final year and in any one previous year.

8. A student who fails in the work of any year will be permitted, unless otherwise ineligible, to register in a subsequent session for the purpose of repeating the year, subject to the following conditions:

(a) Only one such repetition will be allowed in the student's entire undergraduate course. A failure in engineering or in a related course at any other institution will be counted in the same way as a failure in this Faculty.

(b) During any such repetition, the full programme of prescribed instruction must be taken.

(c) Second, Third, or Fourth Year work may be repeated in the session immediately following that in which the failure occurs.

(d) A student who fails in the work for the First Year but who

obtained an average of 50% or over will, provided he is otherwise eligible, be allowed to repeat the work of the year in the following Session. All other students who fail in the work of the First Year must remain out for one Session before re-applying. If a student withdraws on or before 15th February he may re-apply for admission the following Session.

Any student re-applying for admission to the First Year must file a new application (as outlined in Paragraph 5, Section V) with the Registrar of the University.

9. A student whose attendance at lectures or laboratories, or whose work, is deemed by the Council of the Faculty in which he is registered, to be unsatisfactory, may have his registration cancelled at any time by the Council of the Faculty.

10. A student should submit to Council immediately after its occurrence, evidence of any illness or mishap which occurs during the session; any petition for leniency on account of such incidents may be refused consideration if received after the third day following the last day of examinations.

11. A student will not be allowed to write any examinations if he has not paid all fees and dues for which he is liable at that time.

TERM EXAMINATIONS

Term examinations may be held in any subject and at any time at the discretion of the instructor, or by the order of the Council, and the results of such examination may, if the Council so decides, be incorporated with those of the annual examinations in the same subjects.

EXTRA-CURRICULAR ACTIVITIES AND ACADEMIC CREDIT

It is in general desirable for students to engage to a reasonable extent in extra-curricular activities in order that they may not become too narrowly professional in interests and outlook, but it will be obvious that no academic credit or consideration can be given for such activities. Some offices in student organizations require quite large amounts of time for the proper performance of the duties connected with them, and it is therefore strongly recommended that students, particularly those whose academic records are not high, consult a senior member of Staff before allowing themselves to be nominated for such offices.

SECTION X. MEDALS, PRIZES, SCHOLARSHIPS, BURSARIES AND FELLOWSHIPS

Through the generosity of friends of the University, governments and commercial organizations, encouragement has been given to both undergraduate and graduate work in the various branches of engineering studies by establishing the following scholarships, prizes, bursaries, and medals.

Matriculation students are advised to consult the University of Toronto Calendar of Admission Awards for complete details of awards available to students entering this Faculty.

Where it is necessary to make application for an award it is so stated in the description and particulars are given as to how the application should be made. In all other cases the award is made on the recommendation of the Faculty Council and no application is necessary.

In order to be eligible for a medal, prize, scholarship, bursary, fellowship or other awards granted solely upon standing obtained at an annual or special examination or upon an essay, or term work, or other academic rating, a candidate must obtain honours at such annual or special examination or upon such essay, term work, or other academic rating unless the terms of the award or medal specify that standing lower than honours may be accepted.

When an award or medal is granted upon standing obtained on part of the work of any academic year the candidate must obtain standing but need not obtain honours in the work of the academic year as a whole, provided he obtains honours in the part concerned, unless the terms of the award or medal specify otherwise.

No medal, prize, scholarship, bursary, fellowship or other award will be granted to a candidate who is conditioned in any subject at an annual examination or in Physical Education unless the terms of the award or medal specify otherwise.

A candidate will not be permitted to receive more than one award in a session unless the statute establishing each of the awards concerned or the Calendar specifies otherwise. Only one of those marked by an asterisk may be held in any one year. A candidate who would, but for this provision, have received more than one award may have his name so published in the class lists.

A candidate who has spent two sessions in any year of an undergraduate course is not eligible to compete for any award at the annual examinations of that year.

Medals, after they have been suitably engraved, will be given without delay to the winners or forwarded to them by registered mail.

Awards granted to members of graduating classes other than awards for graduate study and research, will be paid in one instalment as soon as possible after the granting of the awards.

All other awards will be paid (i) if of the value of \$100 or less, in one instalment on November 20 and (ii) if of the value of more than \$100 in

two equal instalments, the first on November 20 and the second on January 20, in the session following the granting of the awards. Payment will be made only if the candidate is in regular attendance in the Faculty and, if the Calendar so specifies, in the course in which the award is established or granted.

The Senate may, on the recommendation of the Faculty, permit a candidate to whom an award has been granted to postpone attendance upon lectures and laboratory classes for one year. Further postponement may be permitted on application.

Name	Amount	Application required	Available only to a limited group or single course	See page
AVAILABLE TO STUDENTS ENTERING THE FIRST YEAR				
Alumni Association War Memorial Scholarships......	$500	Yes	No	166
Alcan Scholarship............	$500	Yes	No	144
J. P. Bickell Foundation Scholarships...............	$500	Yes	No	147
J. W. Billes Admission Scholarships...............	—	Yes	No	148
Dominion Magnesium Limited Bursary..................	$400	Yes	Yes	150
Dominion-Provincial Student Aid Bursaries, Type A......	—	Yes	No	150
Engineering Alumni Admission Bursaries........	—	Yes	No	151
Engineering Alumni Admission Scholarship	$500	Yes	No	151
Grabill Admission Scholarship................	$500	Yes	No	153
General Foods Scholarships ...	$500	Yes	No	153
Hagarty Memorial Scholarship.	$60	Yes	Yes	154
The Murray Calder Hendry Scholarship................	$500	Yes	No	155
Inco Scholarship	$300 + Fees	Yes	No.	156
The Leonard Foundation Scholarships.............	—	Yes	Yes	157
J. Edgar McAllister Foundation	—	Yes	Yes	158
O.H.A. War Memorial Scholarship................	$200	Yes	Yes	162
Ontario Chapter American Society for Metals Bursaries (2)...............	$400	Yes	Yes	145

Name	Amount	Application required	Available only to a limited group or single course	See page
A.P.E.O. Admission Scholarship	$500	Yes	No	163
Helen E. Rogers Admission Scholarships......	—	Yes	Yes	165
Simpson-Sears Limited (Northern Ontario) Scholarship......................	$100	Yes	Yes	167
Smith and Stone Limited Bursaries..................	$150	Yes	Yes	167
Walter Sterling Admission Scholarships...............	—	Yes	No	168
U.T.S. Engineering Scholarship.	$250	Yes	Yes	170
Wallberg Admission Scholarships (2)..................	$500	Yes	No	171
AVAILABLE TO STUDENTS COMPLETING THE FIRST YEAR				
Atkinson Incourse Bursaries...	—	Yes	No.	146
Baptie Scholarship............	—	No	Yes	146
Canadian Bechtel Limited Bursaries.................	—	Yes	No	147
J. P. Bickell Foundation Scholarships...............	—	No	No	147
T. H. Bickle Prize............	$30	No	Yes	148
Crocker Foundation Bursaries.	—	Yes	No	149
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	150
*John M. Empey Scholarship...	$100	No	No	151
I.B.M.—Thomas J. Watson Memorial Bursary Fund.....	—	Yes	No	156
Inco Scholarship.............	—	Yes	Yes	156
Johnson's Wax Scholarship....	$600	No	Yes	156
Kimberly-Clark Scholarship ...	$500	No	No	157
John Wolfe McColl Awards....	—	Yes	No.	158
Garnet W. McKee-Lachlan Gilchrist Scholarship in Engineering Physics........	$60	No	Yes	158
MacLennan-LacLeod Memorial Prize.................	$25	No	No	160
*Marsland Engineering Ltd. Scholarship................	$250	No	Yes	160
Northern Electric Undergraduate Scholarship..	$500	No	Yes	161

Name	Amount	Application required	Available only to a limited group or single course	See page
Orenda Engines Scholarship ...	$500	No	Yes	155
*Paulin Memorial Scholarship...	$425	No	Yes	162
Procter and Gamble Bursary..	—	Yes	No	163
*Professional Engineers Scholarship	$250	No	Yes	163
*Ransom Scholarship in Chemical Engineering.......	$150	No	Yes	164
Frederick W. Schumacher Scholarship................	—	Yes	Yes	166
S. Ubukata Fund.............	—	Yes	Yes	169
University Naval Training Division Bursaries..........	$100	Yes	Yes	170
University of Toronto General Bursaries..................	—	Yes	No	170
*Wallberg Undergraduate Scholarships (2)............	$500	No	No	171
AVAILABLE TO STUDENTS COMPLETING THE SECOND YEAR				
*Harvey Aggett Memorial Scholarship	$75	No	No	144
Ardagh Scholarship...........	$300	No	Yes	145
Automotive Transport Association Bursary........	—	Yes	No	142
Babb Bursary Fund..........	—	Yes	Yes	146
Canadian Bechtel Limited Bursaries..................	$1200	Yes	No	147
J. P. Bickell Foundation Bursaries..................	—	Yes	Yes	148
J. P. Bickell Foundation Scholarships	—	No	Yes	147
T. H. Bickle Prize............	$30	No	Yes	148
Carveth Metallurgical Ltd. Bursary...................	$500	Yes	Yes	149
Crocker Foundation Bursaries..................	—	Yes	No	149
Cyanamid of Canada Scholarship	$750	No	Yes	150
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	150
*John M. Empey Scholarship...	$100	No	No	151
J. A. Findlay Scholarship......	—	No	Yes	152
Hugh Gall Award............	$140	Yes	No	153

Name	Amount	Application required	Available only to a limited group or single course	See page
I.B.M.—Thomas J. Watson Memorial Bursary Fund.....	—	Yes	No	156
Johnson's Wax Scholarship	$600	No	Yes	156
The Kennecott Copper Award in Industrial Engineering....	$1000	Yes	Yes	157
Kimberly-Clark Scholarship ...	$500	No	No	157
The Lever Brothers Scholarships...............	$300	No	Yes	158
*Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarships...............	—	No	Yes	159
Charles Gordon Manning Prize	—	No	No	160
*Marsland Engineering Ltd. Scholarship................	$250	No	Yes	160
James L. Morris Memorial Prize	$125	No	Yes	161
Northern Electric Undergraduate Scholarship.......	$500	No	Yes	161
Orenda Engines Scholarship ...	$500	No	Yes	155
*Spruce Falls Power and Paper Company Scholarships.......	$400	No	No	168
William Storrie Memorial Scholarship	$100	No	Yes	168
*Professional Engineers Scholarship..	$250	No	Yes	163
*Rhodes Scholarship	£400	Yes	No	164
Scottish Rite Masons Bursary .	$400	Yes	Yes	166
Frederick W. Schumacher Scholarship...............	—	Yes	Yes	166
Socony-Mobil Oil of Canada Limited Scholarship	$400	No	Yes	167
Edith Tyrrell Memorial Bursary...................	$500	Yes	Yes	169
University of Toronto General Bursaries..................	—	Yes	No	170
*Wallberg Undergraduate Scholarships...............	[illegible]00	No	No	171
*William R. Worthington Memorial Scholarship	$400	No	Yes	171
AVAILABLE TO STUDENTS COMPLETING THE THIRD YEAR				
Allied Chemical Canada Limited Scholarship........	$850	No	Yes	145

Name	Amount	Application required	Available only to a limited group or single course	See page
American Institute of Industrial Engineers Scholarship	$150	No	Yes	145
Babb Bursary Fund..........	—	Yes	Yes	146
F. W. Baldwin Prize..........	$75	No	Yes	146
Canadian Bechtel Limited Bursaries.................	—	Yes	No	147
J. P. Bickell Foundation Bursaries.................	—	Yes	Yes	148
T. H. Bickle Prize............	$30	No	Yes	148
*Boiler Inspection and Insurance Company Scholarship.......	$150	No	Yes	148
*California Standard Company Scholarship	$400	No	Yes	149
Chemical Institute of Canada Prize.....................	$25	No	Yes	149
Crocker Foundation Bursaries .	—	Yes	No	149
Dow Chemical of Canada Limited Award.............	$500	No	Yes	150
Dominion-Provincial Student-Aid Bursaries..............	—	Yes	No	150
*John M. Empey Scholarship...	$100	No	No	151
E.I.C. Prize.................	$50	No	Yes	152
Engineering Society Semi-Centennial Award..........	$75	No	No	152
J. A. Findlay Scholarship......	—	No	Yes	152
James Franceschini Foundation Scholarship................	$250	No	Yes	153
Chester B. Hamilton Scholarship................	$500	No	Yes	154
I.B.M.—Thomas J. Watson Memorial Bursary Fund.....	—	Yes	No	156
*Jenkins Scholarship in Engineering.	$200	No	No	156
Johnson's Wax Scholarship....	$600	No	Yes	156
Kennecott Copper Award in Industrial Engineering....	$1000	Yes	Yes	157
The Lever Brothers Scholarship	$300	No	Yes	158
Loan Funds.................	—	Yes	No	172
J. A. D. McCurdy Prize.......	$75	No	Yes	158
Alexander MacLean Scholar-ship.....................	$250	No	Yes	159

Name	Amount	Application required	Available only to a limited group or single course	See page
*Marsland Engineering Ltd. Scholarship	$250	No	Yes	161
Northern Electric Undergraduate Scholarship	$500	No	Yes	161
Orenda Engines Scholarship	$500	No	Yes	155
*Professional Engineers Scholarship	$250	No	Yes	163
RCE Memorial Scholarship	$125	Yes	Yes	165
Frederick W. Schumacher Scholarship	—	Yes	Yes	166
Specification Writers Association Scholarship	$250	No	Yes	168
William Storrie Memorial Scholarship	$100	No	Yes	168
*Spruce Falls Power and Paper Company Scholarships	$400	No	No	168
Edith Tyrrell Memorial Bursary	$500	Yes	Yes	169
University of Toronto General Bursaries	—	Yes	No	170
*Wallberg Undergraduate Scholarships	$500	No	No	171
AVAILABLE TO STUDENTS COMPLETING THE FOURTH YEAR				
Henry G. Acres Medal	—	No	Yes	144
American Society of Lubrication Engineers Prize	$75	No	No	145
J. P. Bickell Foundation Bursaries	—	Yes	Yes	148
Babb Bursary Fund	—	Yes	Yes	146
Crocker Foundation Bursaries	—	Yes	No	149
Dominion-Provincial Student-Aid Bursaries	—	Yes	No	150
Electrical Manufacturing Co. Limited Prize	$25	No	Yes	151
Encyclopaedia Britannica Prize	—	No	No	151
Hamilton Watch Award	—	No	No	155
Ontario Chapter, A.S.H.R.A.E. Prize	$75	No	No	155
Loan Funds	—	Yes	No	172

Name	Amount	Application required	Available only to a limited group or single course	See page
Massey-Ferguson Ltd. Scholarships (2)............	$500	Yes	Yes	161
Ontario Municipal Electric Association Bursary	$300	Yes	Yes	162
Professional Engineers Gold Medal	—	No	No	164
William Storrie Memorial Scholarship................	$200	No	Yes	168
Society of Chemical Industry Merit Award	—	No	Yes	167
"Second Mile Engineer" Award	$200	No	Yes	166
Trane Company of Canada Limited Prize..............	$200	No	No	169
University of Toronto General Bursaries..................	—	Yes	No	170
W. S. Wilson Medals.........	—	No	No	171
AVAILABLE TO GRADUATES				
Aluminium Laboratories Limited Fellowship.........	$2000	Yes	Yes	175
Athlone Fellowships.........	—	Yes	No	175
J. P. Bickell Foundation Fellowships................	$2000	Yes	Yes	175
C.I.L. Fellowships in Chemistry	$4000	Yes	Yes	175
Canadian Lumbermen's Association Timber Research Fellowship................	$1250	Yes	No	175
Commonwealth Scholarships ..	—	Yes	No	176
Consolidated Mining and Smelting Company Graduate Research Fellowships........	$3000	Yes	No	176
1851 Exhibition Science Research Scholarships......	£275	Yes	Yes	176
Lachlan Gilchrist Fellowship Fund	—	Yes	Yes	177
Thomas H. Hogg Overseas Fellowship................	$3000	Yes	Yes	177
Imperial Oil Graduate Research Fellowships................	$4000	Yes	Yes	178
International Nickel Graduate Research Fellowships	$3000	Yes	Yes	178
Johnson's Wax Fund Scholarship................	—	Yes	Yes	178

Name	Amount	Application required	Available only to a limited group or single course	See page
McCharles Prize..............	$1000	No	No	179
The University of Manchester Toronto Fund..............	£100	Yes	No	179
National Sewer Pipe Limited Scholarship................	$500	Yes	Yes	180
Nipissing Mining Research Fellowships................	$975	Yes	No	180
H. W. Price Research Fellowship in Electrical Engineering	—	Yes	Yes	180
Raymond Priestley Fellowship	£450	Yes	No	180
Rhodes Scholarship...........	£400	Yes	No	164
Royal Institution of Great Britain Science Research Scholarships...............	£350	Yes	No	181
Steel Company of Canada, Ltd., Fellowship.................	$1500	Yes	Yes	181
Spruce Falls Power and Paper Company Fellowships	$1200	Yes	No	181
1940 Toronto Fund...........	£500	Yes	No	181
Wallberg Research Fellowships.	$2500	Yes	No	182
Charles G. Williams Fellowship	$1500	Yes	Yes	182

NOTE—As the value of an endowed scholarship or prize is dependent on the actual income of the fund, it is possible that the value of certain scholarships and prizes at the time of payment may be less than the amount stated in the calendar.

In those cases where the amount of the award is not payable from income earned on an endowed fund, payment will be dependent on the receipt of the amount of the annual award from the donor.

HENRY G. ACRES MEDAL

The Heny G. Acres Medal is the gift of Mrs. Henry G. Acres in memory of her late husband, Henry G. Acres, M.E., D.Sc., a graduate of the School of Practical Science in the class of 1903. Throughout his professional life Dr. Acres was associated with major power developments in Canada and abroad. As chief hydraulic engineer for the Hydro-Electric Power Commission of Ontario in the period 1911 to 1923, he was responsible for the design and construction of nearly twenty power plants, including the Queenston-Chippawa development. Entering private practice in 1924, and until his death in 1945, he continued to widen and extend his interests. He became chief engineer of the Grand River Conservation Commission and responsible for the design and construction of the Shand dam and related work. Later, he was consulting engineer for the extensive power developments at Shipshaw on the Saguenay River, which was vital to the production of aluminum for war purposes. Many of the provinces of Canada sought his services and he advised with respect to work in Newfoundland, South America and India.

This medal is awarded annually to the student in the Fourth Year who is registered in the course in Civil, Mechanical, or Electrical Engineering, and who obtains the highest aggregate percentage at the annual examinations of the Third and Fourth Years, provided always that the student obtains honour standing in the examinations of the Fourth Year. Receipt of the medal does not preclude a student from being granted such other award as may in the opinion of the Council be appropriate.

HARVEY AGGETT MEMORIAL SCHOLARSHIP

This scholarship was donated by the late Mr. J. T. Aggett, of Toronto, as a perpetual memorial to his son, the late Lieutenant Harvey Aggett, who enlisted in March, 1915, during his second year in this Faculty, and was killed in action at Passchendaele on 6th November, 1917.

This annual scholarship of the value of the annual income from the fund is to be awarded to a student of the Second Year in this Faculty who, obtaining honours and being one of the first three in his year by his standing at the annual examinations, has been adjudged highest of the three in general student activities and service in the University during his period of attendance. When regulations do not permit the winner to hold this scholarship the students to be considered for the award shall be the first three in the year exclusive of any student who holds a scholarship of higher value.

ALCAN SCHOLARSHIP

The Aluminum Company of Canada, Limited has made available an admission scholarship of a value of $500.00 to a student entering the First Year of an Honours Course in the Faculty of Arts and Science, the Faculty of Applied Science and Engineering or in the Faculty of Law.

The recipient must attain an academic standing satisfactory to the Committee of Award and demonstrate financial need. It is tenable in the later years provided First Class standing is maintained.

Application should be made to the Registrar of the University by May 1 on the regular Admission Scholarship Application form.

ALLIED CHEMICAL CANADA LIMITED SCHOLARSHIP

Allied Chemical Canada Limited has presented a scholarship of the value of tuition fees plus $250.00 to the student and a grant of $250.00 to the University, to be awarded to a student registered in the Fourth Year of the course in Chemical Engineering who has attained honour standing in the examinations of the Third Year. The recipient must be a Canadian or an American citizen and must not already be receiving other awards exceeding $250.00.

AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS SCHOLARSHIP

The Southern Ontario Chapter, American Institute of Industrial Engineers offers a scholarship of $150.00 to a student entering the Fourth Year of the Industrial Engineering course who has consistently maintained a high academic standing, but not necessarily honour standing, during the previous three years.

AMERICAN SOCIETY OF LUBRICATION ENGINEERS PRIZE

The Toronto Section of the American Society of Lubrication Engineers offers an annual prize of $75.00 to a student in the Fourth Year in Mechanical Engineering whose Thesis dealing with Lubrication is considered by the Head of the Department of Mechanical Engineering to be of suitable quality and the most satisfactory. The Prize is accompanied by a donation of $25.00 to the Department to purchase books on Lubrication.

ONTARIO CHAPTER, AMERICAN SOCIETY FOR METALS BURSARY

The Ontario Chapter, American Society for Metals provides two bursaries of a value of $400.00 each for students entering the First Year in Metallurgy and Materials Science. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than September 1. The first award was made for the Session 1958–59.

ARDAGH SCHOLARSHIP

The Ardagh Scholarship, of the annual value of the income from $6,500, has been provided in memory of his parents by Professor E. G. R. Ardagh, B.A.Sc., F.R.S.C., formerly professor of Applied Chemistry in the Faculty. It is awarded to the student who attains the highest standing

in Honours at the annual examinations of the Second Year in the Course in Chemical Engineering. The first award was made on the results of the annual examination of 1946.

ATKINSON INCOURSE BURSARIES

Atkinson incourse Bursaries, gift of the Atkinson Charitable Foundation, are awarded annually to students in the second or higher years of their courses. Applicants must have at least Second Class Honours in the final examinations of the preceding year, demonstrate financial need and be a resident of the Province of Ontario.

Applications must be submitted to the Registrar of the University on or before December 1st.

ATA TRUCKING INDUSTRY EDUCATIONAL FOUNDATION BURSARIES

The Automotive Transport Association of Ontario has established a bursary fund for students in the second or higher years of any undergraduate degree course who find themselves in serious financial need due to sudden, unexpected personal or family difficulties. Applications may be submitted to the University Registrar at any time during the session and the number and value of the bursaries will vary at the discretion of the Committee of Award.

THE BABB BURSARY FUND

Bursaries from this fund are available to students in any year of the Aeronautics Option in Engineering Science Application is made through the Secretary of the Faculty.

THE F. W. BALDWIN PRIZE

The F. W. Baldwin Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44), in memory of Frederick Walker "Casey" Baldwin, a graduate of the School of Practical Science, who made a significant contribution in the field of Aeronautics in Canada; and who flew, on March 12th, 1908, near Hammondsport, N.Y., the "Redwing," the first biplane built by the Aerial Experiment Association.

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Science, who, taking honours, ranks highest in the annual examinations of Third Year in "structural subjects."

The first award was made on the results of the examinations of the Session 1953–54.

BAPTIE SCHOLARSHIP

The Baptie Scholarship is derived from a bequest under the will of the late Mrs. Margaret W. Baptie, of Ottawa, and the Board of Governors has directed that a scholarship of one half the annual income shall be awarded annually to an engineering student on the record of

the first Year. The Board of Governors also authorizes a remission of fees in the case of the holder of the scholarship, up to Seventy-five Dollars.

The conditions of the award are as follows: That the scholarship be awarded to the student who, in the annual examinations of the First Year, enrolled in any one of the courses of Civil Engineering, Mining Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, or Metallurgy and Materials Science, obtains the highest aggregate percentage of marks in those subjects which are common to the First Year curricula of those courses. The first award was made on the results of the annual examinations of the Session 1925–26.

CANADIAN BECHTEL LIMITED BURSARIES

Canadian Bechtel Limited has established Bursaries in the Faculty of Applied Science and Engineering of an annual value of $1,200.00 to provide not more than four awards, each of a minimum value of $200 and a maximum value of $600. Two awards will be made to First Year students and one or two awards to students registered in any year of the Faculty. Applicants must demonstrate financial need and have academic standing satisfactory to the Faculty Council.

Application must be made to the Secretary of the Faculty on or before October 1st.

J. P. BICKELL FOUNDATION SCHOLARSHIPS

The Trustees of the J. P. Bickell Foundation have established scholarships, the number to be determined annually, in the Faculty of Applied Science and Engineering of a possible value of Fifteen Hundred Dollars, payable $500 in the First Year and provided honours are obtained at the Annual Examinations, $500 in the Second and Third Years.

An applicant must obtain an average of at least 75% at the Ontario Grade XIII examinations immediately preceding his admission to the university and must undertake to enrol in Mining Engineering, Chemical Engineering, Metallurgy and Materials Science or Applied Geology. Failing suitable candidates in the courses mentioned students registered in the Second Year Honour course in Geological Sciences, or Physics and Geology in the Faculty of Arts and Science who are academically qualified are eligible. These awards are of the same value and are tenable in the Second, Third and Fourth Years of the course, subject to maintenance of the required academic standing. If any scholarships are not awarded to those mentioned above, students registered in the Third Year of the Engineering Science course in the Faculty of Applied Science and Engineering and taking the Physical Metallurgy or the Geophysics option who are academically qualified are eligible. In this case the scholarship will have a value of $1,000, payable $500 in each of the Third and Fourth years, provided the required academic standing is maintained.

Applications from those entering First Year must be submitted to the Registrar of the University not later than May 1st on the regular admission scholarship application form. In other cases, applications are not required.

J. P. BICKELL FOUNDATION BURSARIES

The Trustees of the J. P. Bickell Foundation have established the J. P. Bickell Foundation Bursaries in the Faculty of Arts and the Faculty of Applied Science and Engineering. An applicant must be enrolled in Honour Science or in Mathematics, Physics and Chemistry in the Faculty of Arts, in which case he must undertake to study mining or geology in his higher years; or be enrolled in a higher year of an honour course in the geological or geophysical field in the Faculty of Arts; or be enrolled in Chemical Engineering, Mining Engineering, Metallurgy and Materials Science, or Applied Geology in any year of the Faculty of Applied Science and Engineering. He must demonstrate financial need and have satisfactory academic standing.

Application must be made to the Registrar of the University on or before December 1st.

THE T. H. BICKLE PRIZE

The T. H. Bickle Prize is the gift of Mr. and Mrs. E. W. Bickle in memory of their son, T. H. Bickle, an undergraduate of Trinity College and a member of the Senior Intercollegiate Swimming Team at the time of his death in 1937. The income from the endowment fund will be used to purchase a suitable prize to be awarded annually to a member of the Senior Intercollegiate Swimming Team of this University in any year, faculty or school. The Committee of Award shall consist of the Dean of the Faculty of Arts, the University Registrar, the Director of Athletics, and the Honorary Coach of Swimming. In awarding the Prize the Committee shall consider the character, scholarship, and general interests of the members of the team.

J. W. BILLES ADMISSION SCHOLARSHIPS

Admission scholarships have been established from a bequest from the estate of J. W. Billes, open to students entering any degree course in the University. The value in each year is a minimum of $200.00 and a maximum of $1,500.00 dependent upon the financial need of the recipient. Applicants must satisfy the normal admission scholarship standards in their Grade XIII examinations to be eligible for an award and maintain first class honour standing to enjoy the scholarship in higher years. The number of scholarships awarded in any one year may be varied dependent upon the available funds.

Application should be made to the Registrar of the University by May 1 on the regular admission scholarship application form.

BOILER INSPECTION AND INSURANCE COMPANY SCHOLARSHIP

The Boiler Inspection and Insurance Company of Canada offers a scholarship in the Course in Mechanical Engineering of the value of One Hundred and Fifty Dollars to the student who obtains highest honour standing in the regular examinations of the Third Year.

The successful candidate will be expected to proceed to his Fourth Year during the session next following the date of the award.

The amount of the award will be credited by the Chief Accountant to the fees of the Fourth Year of the succsesful candidate.

CALIFORNIA STANDARD COMPANY SCHOLARSHIP

The California Standard Company has presented a scholarship of $400.00 to a student who achieves outstanding results in the annual examinations of the Third Year in the Geophysics Option in Engineering Science or in Applied Geology in the Faculty of Applied Science and Engineering or achieves the highest standing at the annual examinations of the Third Year in Physics and Geology or Geological Sciences in the Faculty of Arts and Science.

The awards alternate annually between the Faculties of Applied Science and Engineering and Arts and Science and the First award was made in the session 1960–61 in the Faculty of Applied Science and Engineering.

CARVETH METALLURGICAL LTD. BURSARY

Carveth Metallurgical Ltd. provides one or more bursaries to a total value of $500 for students entering the Third Year of Metallurgy and Materials Science. The award is made primarily on the basis of Second Year standing, but the need for financial assistance will also be taken into consideration.

The Bursary is available every third year, beginning in the Session 1961–62, and is to be awarded on the recommendation of the Department of Metallurgy and Materials Science. Applications should be made by letter to the Secretary of the Faculty of Applied Science not later than September 1st of the year in which the award is tenable.

CHEMICAL INSTITUTE OF CANADA PRIZE

The Chemical Institute of Canada offers a prize of the annual value of $25.00 in books to the student registered in the course in Chemical Engineering who, having obtained honours, receives the highest standing in the written and laboratory work of the Third Year.

The first award was made on the results of the final examinations of 1947.

CROCKER FOUNDATION BURSARIES

The income from a capital fund established from the estate of the late Beatrice Crocker Glazier in memory of her brother, James William Crocker, provides bursaries for students in the Faculty of Medicine and the Faculty of Applied Science and Engineering who are in need and are worthy of financial assistance.

Application should be made to the Secretary of the Faculty not later than October 15.

CYANAMID OF CANADA SCHOLARSHIP

As a part of their programme to encourage technical development in Canada, Cyanamid of Canada Limited offers a scholarship of the value of $750 to a student entering the Third Year in Chemical Engineering. The award is made to a student who has demonstrated high academic ability and outstanding scholarship in the work of the Second Year.

The first award at the University of Toronto was made in 1964.

DOMINION MAGNESIUM LIMITED BURSARY

Dominion Magnesium Limited provides a bursary of $400.00 for a student entering the First Year in Metallurgy and Materials Science. The award is made primarily on Grade XIII standing but the need for financial assistance is also taken into consideration.

Application should be made by letter to the Secretary not later than 1st September. The first award was made in the Session 1958–59.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "A"

These Bursaries are available to students in financial need who are resident in Ontario, are entering the First Year of University, and have attained an average of at least 66% on eight Grade XIII papers. Application is made not later than June 10th, through the Principal of the secondary school which the student is attending.

DOMINION-PROVINCIAL STUDENT-AID BURSARIES TYPE "B"

Under this programme, Bursaries may be awarded to students in financial need who are resident in Ontario and who are in attendance at the University of Toronto. To be eligible, students must have obtained not less than sixty-six per cent. at their last annual examination. Further information may be obtained from the Secretary of the Faculty, to whom application must be made by the first week in October.

DOW CHEMICAL OF CANADA LIMITED AWARD

Dow Chemical of Canada Limited have provided funds for an annual award of $500.00 to a student in Chemical Engineering in the Faculty of Applied Science and Engineering, and a grant-in-aid of $250.00 to be used in the winner's department to help defray the cost of equipment, supplies and administration.

The winner must:

(a) be registered in the Third Year in Chemical Engineering (the award will be made in the second term of the Third Year and will be paid to the winner during his Fourth Year)

(b) be in the upper half of the class

(c) have demonstrated leadership in extra-curricular activities.

The award is not tenable with other awards in the gift of the Senate. Application is not required.

THE ELECTRICAL MANUFACTURING COMPANY LIMITED PRIZE

The Electrical Manufacturing Company Limited has established an annual Prize of $25.00 in the Faculty of Applied Science and Engineering.

The winner must:

(a) be registered in the Fourth Year in Electrical Engineering

(b) obtain the highest aggregate percentage of marks at the final examinations in the subjects of the Fourth Year related to electrical distribution equipment, the subject to be determined by the Head of the Department of Electrical Engineering.

This Prize is tenable with other awards in the gift of the Senate.

THE JOHN M. EMPEY SCHOLARSHIPS

The John M. Empey Scholarship Fund was established under a bequest of $10,000 in the Will of the late John Morgan Empey, B.A.Sc., 1903. Three scholarships of equal value are provided from the income from the Fund. One of these scholarships is awarded in each of the First, Second, and Third Years on the results of the annual examinations, to a student who, taking honours, obtains the highest average percentage of marks in the written and laboratory subjects of his Year. The scholarships are open to any students registered in the Faculty. In case the winner of any one of these scholarships does not attend this Faculty during the session next following the award, the right to the scholarship shall be forfeited and the award shall be made to another eligible student. The scholarships were awarded for the first time in 1944.

THE ENCYCLOPAEDIA BRITANNICA PRIZE

Encyclopaedia Britannica of Canada Limited presents a prize consisting of a set of books "Great Books of the Western World" to a student of the Fourth Year in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and has achieved high aggregate marks during his four years in the social-humanistic subjects common to all years.

ENGINEERING ALUMNI ADMISSION BURSARIES

The Engineering Alumni Association has made a number of bursaries with a maximum value of $600 each available annually. Applicants must be residents of Ontario, register in the First Year of the Faculty of Applied Science and Engineering, and need financial assistance.

Applicants should consult their secondary school Principal for details. Further information may be obtained from the Chairman, Engineering Alumni Education Committee, Faculty of Applied Science and Engineering, University of Toronto.

ENGINEERING ALUMNI ADMISSION SCHOLARSHIP

The Engineering Alumni Admission Scholarship, the gift of the Engineering Alumni Association, of the value of $500, is awarded to the

candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

ENGINEERING INSTITUTE OF CANADA PRIZE

The Engineering Institute of Canada, having in view that one of its objects is to facilitate the acquirement and interchange of professional knowledge among its members, offers an annual prize of Fifty Dollars in this University, commencing 1931, to the student who, in his Third Year in any one of the six courses of Engineering, has proved himself most deserving as disclosed by the examination results of the year, in combination with his activities in the Engineering Society or with a local branch of another recognized engineering organization.

ENGINEERING SOCIETY SEMI-CENTENNIAL AWARD

The Engineering Society Semi-Centennial Award, to the value of Seventy-five Dollars, was established in 1931 to commemorate the semi-centennial of the founding of the "School". The award is made to a student entering the final year.

The selection is based upon the following qualifications, which bear equal weight in the selection of the winner: (*a*) General "School" activities. (*b*) Contributions to the Engineering Society Executive Committee. (*c*) Personality, and social and athletic activities. (*d*) Academic standing.

J. A. FINDLAY SCHOLARSHIPS

These scholarships were established through a legacy bequeathed by the late Miss Janet Findlay to the Department of Mechanical Engineering. Two scholarships are available, each of a value of one half of the income of the fund, to students in this Course, one for a student in the Third Year, the other for a student in the Fourth Year, but only if the student continues his course in Mechanical Engineering. The selection will be made, on recommendation of the Head of the Department of Mechanical Engineering, from amongst the four students having the highest average percentage of marks at the annual examinations in the Second and Third Years respectively, but in making the award the

student's general character, fitness for his profession, and financial circumstances will be given consideration. In case a student who has been awarded one of the scholarships changes his course or does not attend this University during the next following session, he shall forfeit his right to the scholarship and the award shall be made to another eligible student.

THE JAMES FRANCESCHINI FOUNDATION SCHOLARSHIP

This scholarship, of a value of $250, is awarded to the student in Civil Engineering who achieves the highest standing, with honours, at the annual examinations of the Third Year among those who do not hold an award of a value of $100 or more based on the results of these examinations.

HUGH GALL AWARD

The Hugh Gall Award, of the annual value of One Hundred and Forty Dollars, the gift of the Graduate Class of 1910, "to commemorate a deceased classmate who was a splendid type of student, a loyal friend, and nationally outstanding in athletic achievement during his undergraduate career", was established in 1946 for a five year period and, through the generosity of Mrs. Hugh Gall extended for a further three year period. It is awarded to a student, who, having completed his First Year with a general average of at least 66% without conditions, has entered the Second Year, and is in special need of financial assistance in order to enable him to continue his course. It is desirable, but not necessary, that the recipient shall not already have been given any other scholastic award or scholarship applicable to the Second Year and he shall have shown indications of his firm intention and ability to follow successfully the profession of engineering.

Any second year student in the Faculty of Applied Science and Engineering is eligible to apply for this Bursary. Applications should be made to the Secretary of the Faculty not later than one month after the opening of the session.

GENERAL FOODS SCHOLARSHIP

This scholarship is awarded for general proficiency in the final secondary school year to a student entering the Faculty of Arts and Science, Applied Science and Engineering or Food Science, and is open for competition by any student resident in Canada. The value is $500 for each of four years, providing first class standing in maintained.

Ontario residents apply on the regular admission scholarship application form.

Students resident outside Ontario may obtain application forms from the Awards Department, Office of the Registrar, University of Toronto.

THE GRABILL ADMISSION SCHOLARSHIP

The Grabill Admission Scholarship is the gift of Mr. Dayton L. Grabill, a graduate of this Faculty in 1924. The Scholarship has a value of ap-

proximately $400.00. It is awarded to the candidate who has standing amongst those with the highest average percentages in the subjects of Ontario Grade XIII required for admission to the Faculty of Applied Science and Engineering. Applicants are required to write the Problems paper but standing in this paper is used only as auxiliary information. The candidate must write the Grade XIII examinations at one sitting in the June preceding entry to the University after not more than one year's instruction in Grade XIII and must register in the Faculty of Applied Science and Engineering.

Application should be made to the Registrar of the University on the regular Admission Scholarship form by May 1.

THE REGINALD AND GALER HAGARTY SCHOLARSHIP

The Reginald and Galer Hagarty Scholarship, in memory of the dearly beloved sons of Lieutenant-Colonel E. W. Hagarty, B.A. 1883, M.A. 1908, and Charlotte Ellen Hagarty, his wife. Reginald Edward Walter Hagarty, B.A.Sc. (Honours) 1908, a graduate of the University in the Faculty of Applied Science and Engineering and at the time of his death on April 29, 1925, a Consulting Structural Engineer. Lieutenant Daniel Galer Hagarty, Princess Patricia's Canadian Light Infantry, a member of the class of 1916 in Applied Science, enlisted for the Great War at the end of his third year in June, 1915, killed in action in Sanctuary Wood, June 2, 1916. The scholarship is given in recognition of the fact that their father was an honour graduate in Classics of the University of Toronto. It is of the value of the annual interest on the capital sum of $2000.00 and is to be awarded to a student who has been enrolled for his Grade XIII Year at Harbord Collegiate Institute and having obtained at least the required standing in each of the Grade XIII subjects necessary for admission to the Faculty, obtains the highest standing in English, a language other than English, and Mathematics, among the students who apply for the award from the Collegiate. He will be required to: (*a*) register in the Faculty of Applied Science and Engineering, (*b*) sign a declaration to the effect that he is willing to take up arms in the defence of Canada and the British Commonwealth should necessity arise as declared by the Parliament of Canada. The Scholarship was offered for award for the first time in 1945. Application should be made to the Registrar of the University on the regular admission scholarship application form not later than May 1.

CHESTER B. HAMILTON SCHOLARSHIP

Members of the family of the late Chester B. Hamilton, a graduate of this Faculty in 1906, have presented a Scholarship in his memory of the annual value of $500.00. It is held by a Fourth Year student in Mechanical Engineering who has achieved outstanding academic standing at the Annual Examinations of the Third Year.

The first award was made on the results of the examinations for the Session 1958–59.

HAMILTON WATCH AWARD

Hamilton Watch Company, Lancaster, Pa. presents a wrist watch, suitably engraved, to the Fourth Year student in the Faculty of Applied Science and Engineering who at the annual examinations attains Honour standing and who has achieved high aggregate marks during his four years in the social-humanistic subjects common to all courses.

ONTARIO CHAPTER, A.S.H.R.A.E. PRIZE

The Ontario Chapter of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers offers an annual prize of Seventy-five Dollars, first awarded in 1931, for a period of five years, and extended indefinitely in 1935. The prize will be awarded to a student in either the Third or Fourth Year in any Course of the Faculty who, in the opinion of the Department of Mechanical Engineering, has written the most satisfactory thesis on a subject dealing with heating, ventilating, air-conditioning or refrigeration, such thesis being prepared under special arrangements made by the Department of Mechanical Engineering, the result to be reported to the Council with the annual examination results. The thesis must be handed in not later than February 15. The prize will not necessarily be awarded in any year.

Application should be made to the Department of Mechanical Engineering.

HAWKER SIDDELEY CANADA LIMITED (ORENDA ENGINES DIVISION) SCHOLARSHIPS

Hawker Siddeley Canada Limited (Orenda Engines Division) have donated three scholarships each of a value of Five Hundred Dollars, awarded annually to students completing the First, Second and Third Years respectively in courses other than Mining Engineering and Applied Geology. These scholarships are awarded to students with high academic standing and in cases of close competition, preference will be given to the student who indicates that he possesses initiative and leadership qualities and that he will be a credit to his profession after graduation.

This award may be held with other awards provided that the monetary value of the other awards does not exceed One Hundred Dollars. The first award was made in the Session 1955–56.

THE MURRAY CALDER HENDRY SCHOLARSHIP

This award was established by the estate of Mrs. Grace Appel Hendry as a memorial to her husband, a graduate of this Faculty in 1905. It has a value of the income from a capital sum of $10,000 and the recipient must:

(a) have attained an average of at least 75% on nine grade XIII examination papers, written at one sitting, required for admission to the Faculty and have the highest marks in the Problems paper;
(b) be entering the First Year of any course in the Faculty of Applied Science and Engineering.

Application must be made to the Registrar of the University by May 1 on the regular University Admission Scholarship Application form.

The first award was made in the session 1962–63.

IBM—THOMAS J. WATSON MEMORIAL BURSARY FUND

International Business Machines Company Limited has made available one or more bursaries of a total annual value of $1,000.00 to students registered in any year of a full time course in the university who have standing satisfactory to the Committee of Award and demonstrate financial need.

Application should be made to the Registrar of the University by October 31.

THE INCO SCHOLARSHIP

The International Nickel Co. of Canada Limited has established a Scholarship for students entering the University. Each Scholarship provides for tuition fees plus $300.00 and may be continued throughout a four-year course if satisfactory standing is maintained.

To be eligible for consideration the applicant must obtain an average of 75% or over in the Ontario Grade XIII subjects required for admission to his course and demonstrate financial need.

Application must be made to the Registrar of the University by May 1st on the regular scholarship application form.

JENKINS SCHOLARSHIP

The Jenkins Scholarship, presented by Jenkins Bros., Limited, Montreal, first awarded in 1925, has been donated to continue indefinitely.

This Annual Scholarship, of the value of Two Hundred Dollars, is awarded to the student of the Third Year registered in any course of the Faculty who has the highest aggregate of percentages for the First, Second, and Third Years.

JOHNSON'S WAX SCHOLARSHIP

S. C. Johnson and Son Limited, Brantford, Ontario, have established a Scholarship of an annual value of $600 in each of the Second, Third and Fourth Years or a total possible value of $1800.

The recipient must:

(*a*) be registered in Chemical Engineering in the years in which the Scholarship is awarded and held;

(*b*) in the opinion of the Council be the most promising and deserving member of the class, obtaining Honours in the final examinations of the First Year;

(*c*) in his Second and Third Years, maintain academic standing satisfactory to the Council, not necessarily Honours, for the continued enjoyment of the Scholarship.

In its discretion the Council may recommend the award of any portion

of the Scholarship, lost by the original recipient by failure to maintain satisfactory academic standing, to another student of the year(s) in which the Scholarship would otherwise have been enjoyed.

The first award was made on the results of the annual examinations written in April 1954. It is not tenable with any other Scholarship.

KENNECOTT COPPER AWARD IN INDUSTRIAL ENGINEERING

Kennecott Copper Corporation offers an Annual Award in Industrial Engineering of the value of $1,000.00. The recipient of the Award must:

(a) be registered in the Second, Third or Fourth year of the course in Industrial Engineering;

(b) have attained Honours in the final examinations of the previous year;

(c) show qualities of leadership and initiative.

The financial need of the student may be taken into consideration.

Application should be made to the Secretary of the Faculty by October 15.

KIMBERLY-CLARK CORPORATION OF CANADA LIMITED SCHOLARSHIPS

Kimberly-Clark Corporation of Canada Limited has presented two scholarships of a value of $500.00 each and each scholarship is accompanied by a grant of $100.00 to the general funds of the University. One scholarship is awarded to an outstanding student of the First Year and one to an outstanding student of the Second Year as indicated by the examination results of their respective years. Students in all courses of the First and Second Years are eligible.

The First awards were made on the results of the annual examinations for 1957–58.

THE LEONARD FOUNDATION SCHOLARSHIPS

Leonard Foundation Scholarships are awarded each year to selected students in Universities and Colleges across Canada, including the University of Toronto. The Trust Deed states: "Preference in the selection of students for scholarships shall be given to the sons and daughters respectively of the following: (*a*) clergymen, (*b*) school teachers, (*c*) officers, non-commissioned officers and men, whether active or retired, who have served in His Majesty's military, naval or air forces, (*d*) graduates of the Royal Military College of Canada, (*e*) members of the Engineering Institute of Canada, (*f*) members of the Mining and Metallurgical Institute of Canada."

All applicants must be nominated by a member of the General Committee. The latest date for the receiving of applications is March 31st, for the following academic year. Further information regarding the procedure to be followed in applying for these scholarships may be obtained by writing to Dr. W. E. Taylor, Honorary Secretary, The Leonard Foundation, c/o Toronto General Trusts Corporation, 253 Bay Street, Toronto.

THE LEVER BROTHERS SCHOLARSHIPS

Lever Brothers Limited have established two Scholarships of $300.00 each in the Department of Chemical Engineering. The Scholarships will be awarded to a student of the Second Year and to a student of the Third Year in Chemical Engineering to be held in the Third and Fourth Years respectively. The award is based on outstanding scholarship at the annual examinations.

The first awards were based on the annual examinations of 1957.

THE J. EDGAR MCALLISTER FOUNDATION

Through the generosity of the late J. Edgar McAllister, a graduate of the Faculty in 1891, a fund has been established in the university to be known as the J. Edgar McAllister Foundation, to provide financial aid for students who require it, in Mining, Mechanical, Chemical, Electrical and Metallurgy and Materials Science. Inquiries should be made in the Faculty Office.

THE JOHN WOLFE MCCOLL MEMORIAL AWARDS

These six awards, two of which are open to students in the Faculty of Applied Science and Engineering, are the gift of the estate of the late John Wolfe McColl. The awards have a minimum value of $250.00 and a maximum of $750.00. Applicants must have obtained First Class Honours at the final examinations of the preceding year, whether Ontario Grade XIII or at the University of Toronto, demonstrate financial need and be enrolled or undertake to enrol in either Engineering Science or Chemical Engineering. Students seeking first admission to the University must submit applications for an award to the Registrar of the University on or before May 1st. Students in the University must submit applications for an award to the Registrar of the University on or before October 15th.

THE J. A. D. MCCURDY PRIZE

The J. A. D. McCurdy Prize of a value of $75.00 was established by the trustees of a fund created by the members of the Number 3 Squadron, University Air Training Corps (1941–44) in honour of John Alexander Douglas McCurdy, a graduate of the School of Practical Science, who "made the first flight in Canada on February 23rd, 1909, with a heavier-than-air machine."

It is awarded annually to the student registered in Third Year, Aeronautics Option, in Engineering Science, who, taking honours, ranks highest in annual examinations of the Third Year in the subjects related to Aerodynamics.

The first award was made on the results of the examinations of the Session 1953–54.

THE GARNET W. MCKEE-LACHLAN GILCHRIST SCHOLARSHIP IN ENGINEERING SCIENCE

Mrs. Garnet W. McKee and Professor Lachlan Gilchrist each contributed $1000.00 to provide for a Scholarship in the First Year of the Course in Engineering Science. The value of the Scholarship is the

annual income from the capital fund and is awarded to the student who ranks first in honours at the annual examinations of the First Year in the Course in Engineering Science. If for any reason that student is ineligible to hold the Scholarship, it will be awarded by reversion to the student ranking second in honours in the Course. In order to receive payment the winner must register in the Second Year of the Course in Engineering Science. The Scholarship was awarded for the first time on the results of the annual examinations of 1947.

THE GARNET W. MCKEE-LACHLAN GILCHRIST GEOPHYSICS SCHOLARSHIPS

Financial assistance was received by Professor Lachlan Gilchrist of the Department of Physics, University of Toronto, from certain organizations and individuals to help him in the prosecution of his research work in Geophysics. With the consent of the contributors, the unexpended balance of these gifts was transferred by Professor Gilchrist to the Board of Governors of the University to be used as an endowment for scholarships, two of which were established in the Faculty of Applied Science and Engineering. To this fund have been added additional amounts received from the estate of the late Garnet W. McKee and from the Hollinger Consolidated Gold Mines Ltd. They are awarded by the Senate, on the recommendation of the Council of the Faculty of Applied Science and Engineering. The first awards were made on the results of the Annual Examinations of 1941.

The First Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $4,000.00, is awarded to the student in the Second Year in the Course of Engineering Science who obtains the highest aggregate standing at the examinations of the First and Second Years in the Course, provided always that the student obtains honour standing at the examinations of the Second Year.

The Second Garnet W. McKee-Lachlan Gilchrist Geophysics Scholarship. This scholarship, of the annual value of the income from $3,000.00 is awarded to the student in the Second Year in the Course of Engineering Science who, of those students who elect to proceed in the Third Year in the Geophysics Option of the Course, obtains the highest aggregate standing at the examinations of the First and Second Years, provided always that the student obtains honour standing at the examinations of the Second Year, and excluding always the student to whom the First Lachlan Gilchrist Geophysics Scholarship has been awarded.

If in any year there is no student who has fulfilled the conditions as laid down for the Second Lachlan Gilchrist Geophysics Scholarship, it shall be awarded to the student in the Second Year in the Course in Engineering Science who obtains the second highest aggregate standing at the examinations of the First and Second Years of that Course, provided always that such student obtains honour standing in the examinations of the Second Year.

THE ALEXANDER MACLEAN SCHOLARSHIP

This scholarship was established by graduates of the University of Toronto and other friends in honour of Professor Alexander MacLean,

B.A. (1908) who retired in 1954. The scholarship, of the value of $250, is awarded to a student in the Third Year of Geological Sciences, Faculty of Arts, or in the Third Year of Applied Geology, Faculty of Applied Science and Engineering, who, obtaining not less than 75% in the work of the year, obtains the highest standing in the geological subjects common to the two courses.

The first award was made in 1955.

MACLENNAN-MACLEOD MEMORIAL PRIZE

The Graduating Class of 1910 has donated an annual prize, known as "The MacLennan-MacLeod Memorial Prize", in memory of their first Class President, George MacLennan, who was killed in action in France in 1917, and of Doug. MacLeod, their first Secretary, who died in France in 1916 from wounds received in action.

The prize, of the value of $25, is awarded to the First Year student in the Faculty of Applied Science and Engineering who ranks highest in Calculus among those who obtain standing without condition at the annual written examinations; or, in the event of more than one student obtaining equally high rank in Calculus, the award is made to the one of these who also has the highest standing in some other subject common to the competitors, such as Analytical Geometry, such subject to be determined by the Council of the Faculty.

An award will not be made in any year in which, in the opinion of the Council, no student obtains a sufficiently high standing in Calculus to merit the award. If in any year no award is made, a second award will be available in a subsequent year.

CHARLES GORDON MANNING PRIZE

The Charles Gordon Manning Prize was established by a bequest under the Will of the late Jennie Manning in the amount of Five Hundred Dollars ($500), the annual income from which is to be used to buy books for the winner of the Prize.

The recipient must be enrolled in the Second Year of a course offered by the Faculty of Applied Science and Engineering and, in the opinion of the Council, rank second to the student awarded the Harvey Aggett Memorial Scholarship in the considerations specified for the award of that Scholarship, namely, obtaining honours in his final examinations and being one of the first three in his year by his standing at those examinations relative to the pass requirements in his Department and being "adjudged highest of the three in general student activities and service in the University during his period of attendance."

The first award was made on the results of the Annual Examinations of 1954.

MARSLAND ENGINEERING LIMITED SCHOLARSHIP

The Marsland Engineering Limited Scholarship, the gift of Marsland Engineering Limited, has a value of Two Hundred and Fifty Dollars. It is

awarded to the student who, having been granted a Dominion-Provincial Student Aid Bursary in his First Year, is registered in Mechanical or Electrical Engineering and obtains the highest average percentage of marks, with honours, at the annual examination of the First, Second or Third Years in the session in which the award is made.

The first award was made at the annual examinations of 1954.

MASSEY-FERGUSON LIMITED SCHOLARSHIPS

Massey-Ferguson Limited has established two scholarships each of an annual value of $250.00, to be awarded on the recommendation of the Council of the Faculty of Applied Science and Engineering to students registered in the Fourth Year of the Courses in Mechanical Engineering or Industrial Engineering. In making the award academic achievement, financial need, extra-curricular activities and such other factors as may be deemed appropriate will be taken into consideration.

Application should be made to the Secretary of the Faculty not later than 15th October.

JAMES L. MORRIS MEMORIAL PRIZE

The James L. Morris Memorial Prize is the gift of Mrs. J. H. Craig and Mr. J. R. Morris, K.C., in memory of their father, James L. Morris, C.E., O.L.S., D.Eng., the first graduate of the School of Practical Science, who died in 1946 after a distinguished career. Graduating in Civil Engineering in 1881 as the sole member of his class, Dr. Morris engaged in railway work for some time, first as an engineer and then as a contractor. For 43 years he conducted a successful civil engineering practice in Pembroke, Ontario, involving important undertakings in the field of municipal, power and bridge work.

This Prize, of the value of the annual income from $3,000.00, is awarded annually to the student in the Second Year in the Course in Civil Engineering who obtains the highest aggregate percentage at the annual examinations of the First and Second Years of the course, provided always that the student obtains honour standing at the Examinations of the Second Year.

NORTHERN ELECTRIC UNDERGRADUATE SCHOLARSHIP

The Northern Electric Company Limited have established a Scholarship in the Faculty of Applied Science and Engineering and the Faculty of Arts of an annual value of $500.00. In this Faculty the scholar must be registered in the First, Second or Third Year of Electrical Engineering, Mechanical Engineering, Engineering Science or Industrial Engineering. He must also (a) be a Canadian citizen or landed immigrant and (b) have a minimum of 75% or its equivalent in the previous annual examinations, in this or another recognized University. This scholarship is not tenable with other awards from commercial sources, or with awards stipulating subsequent employment as a condition (e.g. R.O.T.P.)

The award is made alternately in the two faculties, the first in the

Faculty of Arts in 1959 and in the Faculty of Applied Science and Engineering in 1960 and in a similar manner thereafter. Application is not required.

THE ONTARIO HOCKEY ASSOCIATION WAR MEMORIAL SCHOLARSHIP

The Ontario Hockey Association War Memorial Scholarship, the gift of the Ontario Hockey Association, is to be awarded annually at the Grade XIII examination to an applicant whose father served overseas with the Canadian Forces in World War I.

The value of this scholarship is $100 in cash, with an allowance of the same amount on the tuition fee for each session.

In determining the award of the scholarship, the academic qualifications of the candidate shall be first taken into account, provided always that no candidate shall be eligible for an award who has not met all the conditions required by the University of candidates for admission scholarships generally; but, *cæteris paribus*, the award shall be made to a student who is in proved need of assistance.

The award shall be made by the Senate of the University upon the report of a committee to be appointed by the Senate, upon which committee there shall be always one member of the Staff of the University who shall be deemed to be the representative of the Association.

Application should be made to the Registrar of the University on the regular scholarship application form not later than May 1.

ONTARIO MUNICIPAL ELECTRIC ASSOCIATION BURSARY

District No. 4 of the Ontario Municipal Electric Association has provided a Bursary of $300.00 in the Faculty of Applied Science and Engineering.

An applicant for the Bursary must:

(a) be registered in the Fourth Year, Electrical Engineering
(b) have good academic standing
(c) be in need of financial assistance

Application should be made to the Secretary of the Faculty not later than October 15th.

PAULIN MEMORIAL SCHOLARSHIP

The Paulin Memorial Scholarship, provided through the generosity of the late Mr. Fred W. Paulin, a graduate of the Faculty in 1907, was established in memory of his brother, John Cameron Paulin, a student in Mining Engineering, who was fatally injured in 1906 during a football practice. The Scholarship which has a value of annual income from capital fund of $10,000.00, approx. $400.00, is awarded on the recommendation of the Department of Mining Engineering to a student registered in Mining Engineering, who has successfully completed the work of the First Year.

The award is made on the following bases:

(*a*) academic proficiency.

(*b*) qualities necessary for the development of leadership, such as ambition, initiative, resourcefulness and strength of character.

(*c*) he must continue his studies in Mining Engineering during the following session.

The first award was made for the Session 1951–52.

PROCTER AND GAMBLE BURSARY PLAN

Procter and Gamble Bursaries, the gift of the Procter and Gamble Company of Canada, are awarded annually to students in all years. Applicants must have at least Second Class Honours or better in the final examinations of the preceding year and demonstrate financial need. Applications must be submitted to the Registrar of the University on or before December 1st.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO ADMISSION SCHOLARSHIP

The Association of Professional Engineers of the Province of Ontario has established an Admission Scholarship in Engineering of the value of $500.00. It is awarded to the candidate who obtains the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that his attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Application must be made to the Registrar before May 1.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO SCHOLARSHIPS

The Association of Professional Engineers of the Province of Ontario offers Scholarships of a value of $250.00 in each of the First, Second and Third Years in the Faculty of Applied Science and Engineering in any course, to the students who, taking Honours, obtain the highest standing in the work of their respective years.

These scholarships will not be awarded to students who hold other scholarships.

PROFESSIONAL ENGINEERS GOLD MEDAL

The Association of Professional Engineers of the Province of Ontario has established in the Faculty of Applied Science and Engineering an award in the form of a gold medal accompanied by a gift of technical books of an approximate value of fifty dollars. The award will be made to the student of the final undergraduate year in any course who, taking honours, obtains the highest weighted average percentage in the practical work and written examinations of the year.

RANSOM SCHOLARSHIP IN CHEMICAL ENGINEERING

The Ransom Scholarship in Chemical Engineering is presented by A. C. Ransom, Esq., of Toronto, for the purpose of encouraging and giving financial assistance to students who choose the field of Chemical Engineering. This donation, consisting of $5,000, provides for a perpetual scholarship of an annual amount such as will be derived from the income of this sum. The first award was made on the results of the annual examinations of 1938.

The scholarship will be awarded annually to the student registered in the Course in Chemical Engineering who obtains the highest aggregate percentage of marks in the examinations of the First Year. The scholarship will be paid to the winner only if he proceeds to take his Second Year in the Course in Chemical Engineering in the University of Toronto.

THE RHODES SCHOLARSHIP

The Rhodes Trustees offer for award in the Province of Ontario two out of ten of the Rhodes Scholarships for Canadians, each of the value of £900 and tenable at Oxford University for a period of two years; in certain cases, a third year may be authorized.

Each candidate must be a British subject with at least five years domicile in Canada and unmarried; he must have passed his nineteenth but not his twenty-fifth birthday on October 1st of the year *for* which he is elected; he must have completed the first year and have entered upon the second year of his course at a Canadian university at the time of application.

A candidate may apply either for the province in which he has his private home or residence, or for the province in which he has taken his university course.

In that section of the will in which he defined the general type of scholar he desired, Mr. Rhodes mentioned four groups of qualities, the first two of which he considered most important:

(1) Literary and scholastic attainments;
(2) Qualities of manhood, truth, courage, devotion to duty, sympathy, kindliness, unselfishness, and fellowship;
(3) Exhibition of moral force of character and of instincts to lead and to take an interest in his fellows;

(4) Physical vigour, as shown by fondness for and success in outdoor sports.

Some definite quality of distinction, whether in intellect, character or personality, or in any combination of these, is the most important requirement. Financial need does not receive special consideration.

Forms of application and full information regarding these scholarships may be obtained from the Registrar, University of Toronto, or from the secretary of the Ontario Selection Committee, Alistair W. Gillespie, Esq., Suite 1602, 50 King St. W., Toronto. Selection is made in December for the following year and all applications must reach the provincial secretary before November 15 annually.

R.C.E. MEMORIAL SCHOLARSHIP

The Memorial Fund Committee of the Royal Canadian Engineers has established the R.C.E. Memorial Scholarship of a value of One Hundred and Twenty-five Dollars, open to students who have successfully completed their second to last year in the Faculty of Applied Science and Engineering or the School of Architecture.

A candidate must be

(a) a member in good standing of the Canadian Officers Training Corps and have successfully completed one summer season's training

or

(b) an ex-member of the Canadian Officers Training Corps who has successfully completed two years of C.O.T.C. Training and has transferred to the Canadian Army (Militia) or to the Canadian Army (Supplemental Reserve).

or

(c) a member of the Canadian Army (Regular) attending University under the Regular Officers Training Plan.

Selection is made on the basis of academic standing and of qualities of leadership.

Application forms may be obtained from the office of the Registrar.

HELEN E. ROGERS ADMISSION SCHOLARSHIPS

Admission scholarships have been established from a bequest from the estate of Helen E. Rogers open to students entering any degree course in the University. Preference is given to applicants from outside Ontario but failing such candidates awards may be made to qualified Ontario students. Recipients must have a standing satisfactory to the Committee of Award on first admission and may continue to enjoy the scholarship in the upper years provided they maintain first class standing. The value in each year is a minimum of $200.00 and a maximum of $1,500.00 dependent on financial need. The number of awards made each year is determined by the annual income available.

Application should be made to the Registrar of the University by May 1 on the regular admission scholarship application form.

FREDERICK W. SCHUMACHER SCHOLARSHIP

The Frederick W. Schumacher Scholarship has been established in the Faculty of Applied Science and Engineering and in the Faculty of Arts under a bequest of the late Frederick W. Schumacher. It has a value of the income from the fund. The scholar must (a) be enrolled in the Second, Third or Fourth years in Mining Engineering or Applied Geology in the Faculty of Applied Science and Engineering or in Physics and Geology or Geological Sciences in the Faculty of Arts and (b) must have high academic standing.

Applications must be submitted to the University Registrar not later than October 15th.

THE SCOTTISH RITE MASONS' BURSARY

The Scottish Rite Masons' Bursary, the gift of the Scottish Rite Masons of Toronto, of the value of $400.00 is awarded to a student enrolled in the Second Year who is a member of the Masonic Order, or a son, brother, nephew, daughter, sister or niece of a member of the Masonic Order. Consideration will be given to financial need and academic standing. Evidence of connection with the Masonic Order and information regarding financial need must be given with the application which must be submitted to the Secretary of the Faculty on or before October 15th.

"SECOND MILE ENGINEER" AWARD

The Class of 3T5, convinced that a successful engineer must not only be professionally competent but also constantly aware of his responsibilities to humanity, and inspired by an address of President William E. Wickenden of the Case School of Applied Science, Cleveland, called "The Second Mile", which was based on the text from the Sermon on the Mount, "whosoever shall compel thee to go one mile, go with him twain" has established the "Second Mile Engineer" award. It is the desire of the donors to encourage undergraduates to participate fully in extra-curricular activities and to recognize the true importance of the more liberal subjects of the curriculum with the ultimate objective, on entering their profession, of becoming worthy Second Mile Engineers. The award comprises a grant of $200.00, a suitably inscribed presentation piece and an illuminated scroll, and is presented to a student in his final year.

An eligible group is chosen from those who have taken a prominent part in the affairs of the Faculty, either as office holders or in athletics. In making the award consideration is given to academic standing, with special emphasis on the candidate's attainments in the cultural and humanistic-social studies. The subjects which are stressed are English of the First Year; Economics of the Second Year; and Political Science and Modern World History of the Third Year.

Particulars are furnished each session by the Class of 1935.

THE SIMPSON-SEARS LIMITED (NORTHERN ONTARIO) SCHOLARSHIPS

These scholarships, the gift of Simpson-Sears Limited, are open only to students of the Copper Cliff High School, The Sudbury High and Technical Schools, the Sturgeon Falls High School, the North Bay Collegiate Institute and Vocational School, the Kapuskasing High School and all the Secondary Schools along the Ontario Northland Railway. A scholarship of the value of $100 is available for each of the schools mentioned and an additional sum of $50 will be given to the student who obtains the highest percentage of the nine papers of Grade XIII selected in accordance with the regulations.

No scholarship will be awarded unless the candidate is in actual attendance in one of the colleges or faculties of the University and maintains a uniformly high standard to the satisfaction of the donors of the scholarships.

Application for these scholarships must be sent not later than May 15th, to the Principal of the North Bay Collegiate Institute and Vocational School, from whom further information may be obtained regarding conditions of award.

SMITH AND STONE LIMITED BURSARIES

Smith and Stone Limited, Georgetown, Ontario, have provided five Bursaries, each of a possible value of $600 and each payable at the rate of $150 per year to assist deserving students from the Georgetown High School.

The award is made annually by the Senate on the recommendation of the Council of the Faculty to a student:

(*a*) who attended Georgetown High School for at least 2 years and is recommended by the Principal;

(*b*) who has met in full the admission requirements of the Faculty, first class honours not being a requirement.

To be eligible for continued enjoyment of the Bursary the holder must maintain satisfactory academic standing but not required to obtain honour standing.

The award was offered for the first time in the Session 1952–53.

SOCIETY OF CHEMICAL INDUSTRY MERIT AWARD

The Society of Chemical Industry Merit Award is made annually by the Society to the student in Fourth Year in the Department of Chemical Engineering who obtains the highest weighted average of marks in the results of the annual examinations for the year. The award is a gold key.

SOCONY MOBIL OIL OF CANADA LIMITED SCHOLARSHIP

Socony Mobil Oil of Canada Limited has donated a scholarship of the annual value of $400.00, tenable in the Third Year of either the Honours Course in Geological Sciences (Faculty of Arts and Science) or the course in Applied Geology (Faculty of Applied Science and Engineering.

Failing a suitable candidate in either of these courses, an award may be made to a student enrolled in the Third Year of either the Honours Course in Physic sand Geology (Faculty of Arts and Science) or in the Geophysics Option of the course in Engineering Science (Faculty of Applied Science and Engineering.

The award is based on academic performance in the first two years of the course. Other factors, including good character, personality, breadth of interest, initiative, willingness to assume responsibility and ability to co-operate with associates, may be taken into consideration. Applications are not required.

THE SPECIFICATION WRITERS ASSOCIATION SCHOLARSHIP IN CIVIL ENGINEERING

Donated by the Toronto Chapter of the Specification Writers Association of Canada, this scholarship has a value of $250 and is awarded to a student who achieves high standing, with honours, in the annual examinations of the Third Year in Civil Engineering.

The first award of this scholarship was made in the Session 1961–62.

SPRUCE FALLS POWER AND PAPER COMPANY LIMITED SCHOLARSHIPS

The Spruce Falls Power and Paper Company Limited has established four Scholarships of a value of $400.00 each, two in the Second Year and two in the Third Year. They are awarded on the results of the Annual Examinations of the Second and Third Years to the students who obtain honour standing at the examinations of their respective years and are open to students in all courses in the Faculty. The first awards were made on the results of the examinations of 1951.

Each scholarship carries a grant of $150 to the University General Funds.

WALTER STERLING ADMISSION SCHOLARSHIPS

Established in memory of Walter Sterling, these scholarships are open to students entering any first degree course at the University of Toronto. Recipients must obtain First Class Honours standing on the nine Ontario Grade XIII papers required for admission, and may continue to enjoy the scholarships in each year of their course providing they maintain Honour standing. The value of the scholarship is from $200.00 to $1,500.00 annually, dependent on financial need. The number of awards made each year is determined by the annual income available.

Application should be made to the Registrar of the University on the regular scholarship application form. The statement of financial need should be completed if an award greater than $200.00 is desired.

THE WILLIAM STORRIE MEMORIAL SCHOLARSHIPS IN CIVIL ENGINEERING

Three Scholarships have been established by Mrs. William Storrie in memory of her husband, the late William Storrie, a Consulting Engineer

on many municipal projects in Canada and for several years a special lecturer in the Faculty of Applied Science and Engineering, for students in Civil Engineering, as follow:

(a) Of a value of $100 to a student who obtains high standing in the annual examinations of the Second Year in Civil Engineering.

(b) Of a value of $100 to a student who obtains high standing in the annual examinations of the Third Year in Civil Engineering.

(c) Of a value of $200 to the student who obtains the highest standing in the annual examinations of the Fourth Year in the Municipal and Sanitary Option of the course in Civil Engineering.

In all cases the candidates shall have demonstrated qualities of integrity and shown promise of leadership in their profession.

The first awards were made for the Session 1956–57.

THE TRANE COMPANY OF CANADA LIMITED PRIZE

The Trane Company of Canada Limited has established an annual Prize of $200.00 in the Faculty of Applied Science and Engineering. The recipient may be registered in the Fourth Year in any course and the Prize will be awarded for the best Thesis on air-conditioning or refrigeration, either for comfort cooling or industrial use.

This award is tenable with other awards in the gift of the Senate. Application is not required.

EDITH TYRRELL MEMORIAL BURSARY

The Women's Association of the Mining Industry of Canada has presented this Bursary, having the value of Five Hundred Dollars, annually, commencing in 1939, and named in memory of their founder and first president, Mrs. Edith Tyrrell. A medal donated by Dr. Tyrrell accompanies the Bursary. The Bursary is awarded to a student entering the Third or Fourth Year in the Course in Mining Engineering, Metallurgy and Materials Science, or Applied Geology; it may be awarded two years in succession to the same student, but will usually be awarded at the beginning of the Third Year. The award will be made by a special committee appointed by the Association on the following basis:

(*a*) In addition to mental capacity, the student must show leadership ability and give promise, through his activities, of becoming a worthwhile influence in the affairs of the profession and the community.

(*b*) While attention is given to scholastic ability, as evidenced by his academic standing, it is not the governing factor. He must, however, stand in the top quarter of his class.

(*c*) Special consideration is given to financial need.

Application must be made to the Secretary of the Faculty within one month of the opening of the academic year.

S. UBUKATA FUND

The S. Ubukata Fund for Japanese students was established to assist students from Japan proper to pursue a course of study at the University

of Toronto. The fund provides grants of varying values on the basis of the information submitted by the applicants who:—

(i) must be Japanese students from Japan proper;
(ii) must register in the University of Toronto devoting full time to their studies;
(iii) are able to satisfy admission requirements regarding English facility;
(iv) are not holding other financial aid.

UNIVERSITY OF TORONTO ALUMNI ASSOCIATION WAR MEMORIAL SCHOLARSHIPS

Six scholarships are awarded annually by the University of Toronto Alumni Association to students entering first degree courses at the University of Toronto. The scholarships have a value of $500.00 annually, and are tenable for two years, providing satisfactory academic standing is maintained. They are awarded for general proficiency in Grade XIII, and in addition to academic performance the committee of award will take into consideration the candidate's relationship to active service in the Armed Forces of Canada, need of financial assistance, participation in extra-curricular activities and such other qualifications as may commend themselves to the committee. One scholarship will be available to a student whose home is not in the Province of Ontario.

Students resident in Ontario may apply on the general admission scholarship form which must be submitted to the Registrar of the University not later than May 1. Evidence of relationship to active service in the Armed Forces of Canada should be attached. Students resident out side Ontario may obtain the necessary forms from the Awards Department, Office of the Registrar, University of Toronto.

UNIVERSITY NAVAL TRAINING DIVISION BURSARIES

The University Naval Training Division Bursaries, the gift of the University Naval Training Division, are of the value of $100 each. As many as three bursaries may be awarded in each session; if fewer than three are awarded those not awarded may be given in a subsequent session. A candidate must be registered in the University for a full-time course leading to a diploma or degree and must be at the time of the award a member of one of the recognized military training units within the University. Application must be made to the University Registrar before the end of November.

UNIVERSITY OF TORONTO GENERAL BURSARIES

The Board of Governors has established a fund to provide bursaries for deserving students who without financial assistance cannot continue their formal education. Further information may be obtained from the Secretary of the Faculty.

THE U.T.S. ENGINEERING SCHOLARSHIP

The U.T.S. Engineering Scholarship, the gift of R. A. Bryce, Esq., of the value of $250. The scholarship will be awarded by a committee of

the Staff of the University of Toronto Schools to a student of the Schools who has completed the requirements for admission to and enrols in the Faculty of Applied Science and Engineering.

WALLBERG ADMISSION SCHOLARSHIPS

Two admission scholarships, each of a value of $500.00 are awarded annually from the income from the Wallberg Bequest on the recommendation of the Council of the Faculty to the two candidates who obtain the highest average percentage in the subjects of Grade XIII prescribed for admission to the Faculty of Applied Science and Engineering; applicants are required to write the Problems paper for Scholarship candidates, but the standing on this paper will be used only as auxiliary information. In order to qualify for the scholarship a candidate must at one Scholarship examination obtain an average of at least seventy-five per cent. in the subjects of Grade XIII prescribed for admission to the Faculty and must register in the Faculty of Applied Science and Engineering. The scholarship will not be awarded to a student who has spent more than one year in Grade XIII or more than five years in a Secondary School or its equivalent unless he can show evidence satisfactory to the Council that this attendance has been extended beyond the period specified for reasons beyond his control. This scholarship is not tenable with any other Admission scholarship.

Applications must be submitted to the Registrar on the prescribed form by May 1st.

WALLBERG UNDERGRADUATE SCHOLARSHIPS

These scholarships, four in number, of the value of $500.00 each, derived from the Wallberg Bequest, are awarded annually; two to students ranking first and second respectively at the annual examinations of the First Year; one to the student ranking first at the annual examinations of the Second Year; and one to the student ranking first at the annual examinations of the Third Year.

Any holder of one of these scholarships may not hold other awards listed in the index with an asterisk. The awards were first made on the result of the annual examination of 1947.

W. S. WILSON MEDALS

These medals have been provided in recognition of the service to the Faculty of Applied Science and Engineering of its former Assistant Dean and Secretary, William Stewart Wilson.

A medal will be awarded to the student in each graduating course, who, attaining Honours, achieves the highest standing in the final year of his course.

The first awards were made in the Session 1962–63.

WILLIAM R. WORTHINGTON MEMORIAL SCHOLARSHIP

The William R. Worthington Memorial Scholarship, the gift of Miss Ida R. Worthington, in memory of her brother, William R. Worthington,

Dip.(1904), B.A.Sc.(1905), of the value of the income from a fund is awarded annually to the student of the Second Year in the course in Civil Enginering who ranks highest at the anual examinations of that year.

The first award was made at the examinations for the Session 1954–55.

LOAN FUNDS

From the loan funds mentioned below, small loans can be made to students who are in urgent need of assistance. The funds are not large and the loans must accordingly be restricted, both in amount and number, and principally to students in the Third and Fourth Years.

Enquiries for loans from any of the following funds should be made at the office of the Secretary of the Faculty.

Engineering Alumni Loan Fund
Engineering Society Loan Fund
Elizabeth Speller Memorial Fund
James W. Crocker Memorial Fund
Harry F. Bennett Educational Fund
S.A.E.—Canadian Section Loan Fund
Class of 2T7 (SPS) Memorial Loan Fund
Avro Aircraft Limited Engineering Loan Fund
Association of Professional Engineers Loan Fund
The William Storrie Memorial Fund
3T6 Engineers Loan Association
4T0 Engineering Loan Fund
Women's Association of the Mining Industry in Canada Loan Fund
The Devonshire Loan Fund
Class of '09 Trust Fund
University of Toronto Alumni Loan Fund
University of Toronto General Loan Fund

CLASS OF 1936 LOAN ASSOCIATION

Members of the Class of 1936 have made arrangements to assist students in obtaining loans through regular banking facilities. Information may be obtained from the Secretary of the Faculty.

ENGINEERING ALUMNI LOAN FUND

The Engineering Alumni Association established in 1950 a loan fund to assist engineering students, especially in the Third and Fourth Years.

Applications for loans from this fund should be made to the Secretary of the Faculty.

CLASS OF 2T7 (SPS) MEMORIAL LOAN FUND

This fund was established in 1955 to memorialize the Class of 1927 of the Faculty of Applied Science and Engineering.

Loans to a total of $250 are available to any undergraduate who has completed one Year, with or without conditions, and who has qualified for the Second, Third or Fourth Year.

Application shall be made to the Secretary of the Faculty.

ENGINEERING SOCIETY LOAN FUND

In 1932 the Engineering Society repaid to the Board of Governors a series of annual grants which, over a period of years, had been made to the Society for special purposes. The Board of Governors, appreciating this action, set aside this sum, to be known as the Engineering Society Loan Fund, to provide loans to students of the Faculty of Applied Science and Engineering. The administration of the fund is carried out by a Committee appointed by the Board. The fund is not large, and only small loans can be made to relatively few students. Further inquiries should be made at the office of the Secretary of the Faculty.

ELIZABETH SPELLER MEMORIAL FUND

Through the generosity of Dr. F. N. Speller, of the Class of 1893, the "Elizabeth Speller Memorial Fund" has been established to provide loans for worthy students of the Third and Fourth Years of this Faculty. Applications for loans from this Fund should be made to the Secretary of the Faculty.

JAMES W. CROCKER MEMORIAL LOAN FUND

This fund was established by Mrs. William Crocker in memory of her son, James W. Crocker, a graduate in Mining Engineering in 1938, who was killed in an accident in a mine in the same year.

HARRY F. BENNETT EDUCATIONAL FUND

This fund was established by subscription from members of The Engineering Institute of Canada in memory of the late Harry F. Bennett, M.E.I.C., who for six years prior to his death in 1946 was chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, and who accomplished so much in this field by untiring efforts.

One purpose of the fund is to make loans to deserving students who need financial assistance to enable them to study engineering sciences at university level, and who have proved themselves by successfully completing their first year in engineering or the equivalent.

Loans will be made largely on the basis of character and to men who seem likely to develop the high professional standards which are essential to leadership in engineering science. A student who has been aided by this fund should feel that high obligations are placed on him; obligations to the subscribers, to the trustees, and to those coming after him who in turn can receive help as his loan is repaid.

Application forms may be obtained at the Faculty Office. The regulations are simple and the application of any worth-while student will be given immediate and careful attention.

SOCIETY OF AUTOMOTIVE ENGINEERS—CANADIAN SECTION LOAN FUND

The Society of Automotive Engineers—Canadian Section has established a loan fund of $1,200.00 in the Faculty of Applied Science and Engineering. Preference is given to students in good scholastic standing and engaged in studies relative to the automotive and aircraft industries, and to students in fourth, third and second years in that order. Particulars may be obtained from the Secretary of the Faculty.

AVRO AIRCRAFT LIMITED ENGINEERING LOAN FUND

Avro Aircraft Limited has established a Loan Fund of $3,000.00 to provide loans to engineering students requiring financial assistance. Application should be made to the Secretary of the Faculty.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF ONTARIO LOAN FUND

The Association of Professional Engineers has made loans not exceeding $200 available to students in the First, Second and Third Years in this Faculty. Application should be made to the Association at 236 Avenue Road, Toronto.

THE WILLIAM STORRIE MEMORIAL FUND

The William Storrie Memorial Fund has been established by Mrs. William Storrie to provide loans to undergraduates in the course in Civil Engineering. Application should be made to the Secretary of the Faculty.

THE DEVONSHIRE LOAN FUND

This Fund has been established by Graduates and friends of Devonshire House to assist students in the Residence. Application should be made to the Office of the Dean of Devonshire House.

CLASS OF '09 TRUST FUND

The Class of '09 on the 50th Anniversary of their graduation made a sum of money available in the Faculty for financial aid to undergraduates, with preference to Second Year students. Inquiry should be made to the Secretary of the Faculty.

THE UNIVERSITY OF TORONTO ALUMNI LOAN FUND

This fund comes from subscriptions received originally in 1919 and in succeeding years from graduates of the University and is administered by the University of Toronto Alumni Association.

Loans are available to undergraduate and graduate students enrolled in a full time course at the University, in second and subsequent years.

Particulars may be obtained from The University of Toronto Alumni Association, Alumni House, 18 Willcocks Street, Toronto, or from the Secretary of the Faculty or School.

GRADUATE SCHOLARSHIPS AND FELLOWSHIPS

ALUMINIUM LABORATORIES LIMITED FELLOWSHIP

The Aluminium Laboratories Ltd. have established a fellowship valued at $2,000 plus fees. This award will be held in the School of Graduate Studies by a candidate for a Master's or a Doctor's degree in the fields of mathematics or physical sciences, pure or applied, preference being given to students in the field of physical metallurgy.

THE ATHLONE FELLOWSHIPS

Her Majesty's Government in the United Kingdom has established a number of fellowships to be awarded annually to enable Canadian engineering graduates to take postgraduate training in the United Kingdom. These became available in 1951 when five fellowships were open to graduates of the University of Toronto immediately after graduation. Additional fellowships are for award to graduates who have already spent some time in industry. The fellowships cover costs of transport, fees and maintenance and are normally tenable for a period of two years. They may be utilized for (*a*) works training in industry, (*b*) postgraduate university study, or (*c*) a combination of these. Candidates must be Canadian citizens or British subjects normally resident in Canada and should preferably be less than 27 years of age. Further information and application forms may be obtained from the Secretary of the Faculty.

J. P. BICKELL FOUNDATION FELLOWSHIPS

These fellowships, of a value of $2,000 annually, are open to students registered in the School of Graduate Studies and pursuing studies in Metallurgy and Materials Science or Geological Sciences. Applications must be submitted to the Secretary of the School of Graduate studies not later than March 1.

THE C.I.L. FELLOWSHIPS

Two Fellowships, the gift of Canadian Industries (1954) Limited, of the value of $2,000 each are established for the encouragement of postgraduate work in Chemistry. An applicant must be a university graduate who is a Canadian citizen or a graduate who intends to follow a career in Canada, with preference to Canadian citizens. The holders of these Fellowships will be required to undertake research in any branch of Chemistry under the direction of the department designated by the Committee of Award. Application must be made, with full statement of qualifications and testimonials, to the Secretary of the School of Graduate Studies not later than March 1st.

CANADIAN LUMBERMEN'S ASSOCIATION TIMBER RESEARCH FELLOWSHIP

This fellowship, donated by the Canadian Lumbermen's Association, is offered to encourage advanced study and research in timber engineering. It is open to graduates in engineering and graduates in forestry of

any recognized university. The fellow must be registered in the School of Graduate Studies as a student proceeding to a post-graduate degree and must carry out a prescribed programme of study and research in both engineering and forestry. It is intended that the work of this programme will extend over a period of two academic years. The annual value of the fellowship is $1,250, all of which might not be granted to one student.

Application should be made to the Secretary of the School of Graduate Studies not later than September 1st and should be accompanied by an official transcript of the applicant's undergraduate record, together with a statement of his experience in the forestry and construction fields.

COMMONWEALTH SCHOLARSHIPS

Under a Plan drawn up at a conference held in Oxford in 1959, each participating country of the Commonwealth offers a number of scholarships to students of other Commonwealth countries. These scholarships are mainly for graduate study and are tenable in the country making the offer. Awards are normally for two years and cover travelling, tuition fees, other university fees, and a living allowance.

For details of the awards offered by the various countries consult the Registrar's Office, or write to The Canadian Universities Foundation, 75 Albert Street, Ottawa.

CONSOLIDATED MINING AND SMELTING COMPANY GRADUATE RESEARCH FELLOWSHIPS

The Consolidated Mining and Smelting Company of Canada Limited offers 10 graduate research fellowships of a value of $3000.00 each ($2200.00 to the student and $800.00 to the University) to graduates in pure or applied science or agriculture for research leading toward a higher academic degree at a Canadian university. The subject of the research shall be in some field of pure or applied science related to the broad chemical interests of the Company in the fields of Mining, Geology, Metallurgy, Chemistry, Chemical Engineering, Physics, Agriculture, and Electrical, Mechanical and Civil Engineering. Applications must be made on forms available from the Registrar's Office and submitted to the Director of Awards, Canadian Universities Foundation, 75 Albert Street, Ottawa 4, not later than February 1st in the year for which the application is made.

THE 1851 EXHIBITION SCIENCE RESEARCH SCHOLARSHIPS

The Royal Commissioners for the Exhibition of 1851 offer 3 scholarships valued at £750 each, to Canadian students each year. These awards are supplemented by a grant of £250 per annum from the National Research Council of Canada, which does not affect the basic stipend or any travel allowance which may be granted by the Commissioners.

Each candidate recommended must be a British subject, and under

twenty-six years of age except in very special circumstances; he must have been a student of science in a university institution for a period of not less than three years and must have spent one full academic year at this University ending not more than twelve months prior to the date of recommendation.

The record of a candidate's work must indicate high promise of capacity for advancing science or its applications by original research. Evidence of this capacity, which is the main qualification for the scholarship, is strictly required. The most suitable evidence is a satisfactory account by the candidate of research work already performed, and the Commissioners will decline to consider the claims of a candidate unless such an account is furnished, or unless there is other equally distinct evidence that he possesses this qualification.

The scholar will be required to devote his whole time to research in some branch of pure or applied science at an institution in the United Kingdom or abroad, selected with the approval of the Commissioners.

The following are the departments of the University, the students of which are eligible to apply for these scholarships: 1. Bacteriology; 2. Biochemistry; 3. Botany; 4. Chemistry; 5. Engineering (chemical); 6. Engineering (civil); 7. Engineering (electrical); 8. Engineering (mechanical); 9. Engineering (metallurgical); 10. Engineering (mining); 11. Forestry; 12. Geological Sciences; 13. Physics; 14. Physiology; 15. Zoology.

A student shall not be deemed to be ineligible because of his being on the staff of the university, if he has not been in receipt of a salary of more than $800 per annum and the nominating board may, at its discretion, recommend candidates who have been in receipt of larger salaries provided that all other conditions are fulfilled.

A student shall be deemed to be eligible in the year in which he intends to graduate, but if nominated for the scholarship his nomination shall be subject to his being successful in passing his examination for his degree.

The nominating board is appointed by the Senate and has power to call to its aid as assessor any member of the teaching staff.

Applications for these scholarships must be submitted not later than March 1st to the University Registrar from whom copies may be obtained of the general regulations of the Commissioners governing the award and tenure of the scholarship.

LACHLAN GILCHRIST FELLOWSHIP FUND

This fund provides four fellowships to the value of the available income from the capital sum of $137,000, to be awarded to graduate students in fundamental physics who enrol in the School of Graduate Studies at the University of Toronto.

Applications should be submitted to the Secretary of the School of Graduate Studies by March 1 annually.

THOMAS H. HOGG OVERSEAS FELLOWSHIP

This fellowship was established by Mrs. T. H. Hogg in 1962, in memory of the late Thomas H. Hogg, B.A., C.E., D.Eng., an honour

graduate of the Faculty of Applied Science and Engineering. It is to be awarded to a Canadian candidate for study, beyond the North American continent, in the field of hydraulics, fluid mechanics or power system engineering.

Annual value of the fellowship is $2,250.00 with an allowance for travel and tuition to a maximum of $750.00. Application should be made before January 1st to the Dean, Faculty of Applied Science and Engineering.

IMPERIAL OIL GRADUATE RESEARCH FELLOWSHIPS

Imperial Oil Limited offers annually five graduate research fellowships in order to promote and encourage academic research in the technical and administrative aspects of industry, and public interest within Canada in the further advancement of knowledge.

Three fellowships are offered in Pure and Applied Natural and/or Exact Sciences, including Mathematics; two are offered in the Social Sciences and Humanities.

Tenable at Canadian and other Universities, the fellowships are valued at $2,500 each per annum. A fellow may not hold other awards equalling or exceeding $1,500 annually.

Application forms may be obtained from the Office of the Registrar and should be returned to the Secretary of the Imperial Oil Committee on Higher Education, 111 St. Clair Avenue West, Toronto 7, not later than March 1 for the following session.

THE INTERNATIONAL NICKEL GRADUATE RESEARCH FELLOWSHIPS

The International Nickel Company of Canada has established a number of Graduate Research Fellowships, to promote and encourage research in the technical fields serving the Canadian metal industries and to further public interest in industrial science in Canada. Each has a possible tenure of three years with an annual payment of $3,000, of which $2,500 is payable to the fellow and $500 is placed at the disposal of the directing professor for necessary materials or equipment. It is expected that four new fellowships will be awarded in 1961.

Applications on behalf of competent graduate students will be considered from any Canadian university qualified to confer the Master's or Doctor's degree in Geology (including Geophysics), Mining, Ore Dressing, Metallurgy (both process and physical), Chemistry (pertaining to metals), Physics (pertaining to metals), and Mathematics. Awards are made by a committee appointed by the National Conference of Canadian Universities and Colleges.

Application is made through the University department concerned to the International Nickel Company of Canada, Limited, 55 Yonge Street, Toronto 1, Ontario, not later than February 14.

JOHNSON'S WAX FUND SCHOLARSHIP

The Johnson Foundation through S. C. Johnson and Son Limited, Brantford, Ontario, offers one scholarship each year for study in a United

States College or University in postgraduate fields of study such as economics, business administration, chemistry, engineering, teaching, etc. The amount of the scholarship varies according to the requirements of each student.

Further information and preliminary application forms which must be submitted to the company not later than December 15 may be obtained from the Registrar of the University.

MCCHARLES PRIZE

This prize, the gift of the late Æneas McCharles of the value of $1,000, is awarded from time to time but not necessarily every year on the following terms and conditions: (1) to any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved to be of special merit on a practical scale; (2) or for any important discovery, invention or device by any Canadian that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light; (3) or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line. The following conditions determine the method of award.

(1) The title shall be the McCharles Prize.

(2) The value of the prize shall be One Thousand Dollars ($1,000) in money.

(3) Every candidate for the prize shall be proposed as such in writing by some duly qualified person. A direct application for a prize shall not be considered.

(4) The composition of the awarding body shall be as follows:—

An expert in Mineralogy,
An expert in Electricity,
An expert in Physics,

and four other persons. All of the members of this body shall be nominated by the Board of Governors of the University of Toronto.

THE UNIVERSITY OF MANCHESTER TORONTO FUND

The University of Manchester has accepted the gift of a sum of £1,699 from a Committee representing the parents of children who during the war were evacuated to Toronto and other places in Canada. The capital and any income arising therefrom will be used to make grants to Canadians wishing to conduct post-graduate studies and/or research in the University of Manchester, preference being given to students who have graduated from the University of Toronto. The total amount of grant or grants to any student will not exceed £100. Applications must be submitted to the Registrar of the University of Toronto on or before January 1st of the year in which the applicant wishes to enter the University of Manchester, together with transcripts of undergraduate and graduate record and outlines of the post-graduate studies and/or research to be followed at the University of Manchester.

NATIONAL SEWER PIPE COMPANY LIMITED SCHOLARSHIP

The National Sewer Pipe Company Limited has established a scholarship of a value of Five Hundred Dollars ($500.00) in the School of Graduate Studies. It is awarded annually to a student who undertakes to enroll in that School, proceeding to the degree of Master of Applied Science in the graduate Department of Civil Engineering and in the course in Public Health Engineering.

Applications must be submitted to the Secretary of the School of Graduate Studies on or before March 1st.

NIPISSING MINING COMPANY RESEARCH FELLOWSHIP

The Nipissing Mining Company has endowed a Research Fellowship in the Department of Mining Engineering, to be known as The Nipissing Mining Company Research Fellowship, of the annual value of the income from the fund, plus free tuition.

This Fellowship is open to graduates of any University.

H. W. PRICE RESEARCH FELLOWSHIP IN ELECTRICAL ENGINEERING

The H. W. Price Research Fellowship in Electrical Engineering consisting of the income or a part thereof but not exceeding the income for three years derived from the sum of $10,000 donated by the Hydro Electric Power Commission of Ontario, will be awarded from time to time as recommended by the School of Engineering Research, to a graduate in Electrical Engineering of any recognized University, registered in the School of Graduate Studies, wishing to proceed with an investigation in the field of Electrical Engineering.

Forms of application may be obtained from the Secretary, School of Graduate Studies, and should be returned with a statement of qualifications not later than March 1st. The first award was available in 1943.

THE RAYMOND PRIESTLEY FELLOWSHIP

The University of Birmingham being "anxious to mark its indebtedness and its gratitude" for the hospitality shown during the Second World War to children of members of its teaching staff by members of the University of Toronto, has set aside a research fellowship to be held by a graduate of the University of Toronto. This fellowship, to be known as the Raymond Priestley Fellowship, of the value of £450 per annum as well as the cost of the return passage from Canada, is available for graduates, both men and women, preferably those who have already shown some capacity for and interest in research. The fellowship will normally be awarded for a period of three years. It is tenable in any faculty of the University of Birmingham. The Fellow will undertake research and may, if he wishes, be a candidate for a higher degree at the University of Birmingham. The selection of the candidate will be made by the University of Toronto. The process of selection will include

negotiation with the head of the department concerned in the University of Birmingham to ensure that there is in the University opportunity for the pursuit of the particular line of research required. Applications must be submitted to the University Registrar not later than March 1st, together with transcripts of undergraduate and graduate records and outlines of the research to be undertaken at the University of Birmingham.

THE ROYAL INSTITUTION OF GREAT BRITAIN SCIENCE RESEARCH SCHOLARSHIPS

A scholarship of the value of £350 per annum with a possible additional allowance of £50, to be held ordinarily for a period of two years, will be offered each year to a candidate from one of the universities of Canada, Australia, New Zealand and South Africa, and is tenable only in the Davy Faraday Research Laboratory of the Royal Institution, London. No candidates will be considered except those who have been recommended for the 1851 Exhibition Science Research scholarships, and candidates who wish to be considered also for the Royal Institution scholarships are requested to state this clearly in the application for an 1851 scholarship. No other application to the Royal Institution is necessary. Copies of the regulations relating to these scholarships may be obtained from the University Registrar.

THE STEEL COMPANY OF CANADA LIMITED FELLOWSHIPS IN METALLURGY

Four Fellowships, each of the value of $3,000, out of which $2,000 will be awarded to the successful candidate and $1,000 to the university at which he or she studies, are offered to permanent residents of Canada who are graduates of a Canadian university. The fellowships are normally tenable for one year but in special circumstances may be renewed for a second year. Applications must be made in triplicate on the approved form to The Secretary, Canadian Universities Foundation, 75 Albert Street, Ottawa. Forms may be obtained from the relevant department in your university, from the Registrar's office, or from the above address.

SPRUCE FALLS POWER AND PAPER COMPANY, LIMITED, FELLOWSHIP

The Spruce Falls Power and Paper Company Limited has established a Fellowship for the encouragement of research in the Faculty, of an annual value of $1200. It is open to graduates of the University of Toronto or of other recognized universities, but is restricted to Canadian Citizens. Application should be sent to the Secretary of the School of Graduate Studies, not later than March 1st.

The Fellowship also carries a grant of $300 to be applied to the tuition of the holder and $300 to the general University Funds.

THE 1940 TORONTO FUND

The 1940 Toronto Fund, the gift of Oxford University, of the value of £3000, was set up in 1940 by the parents of Oxford children who were

taken into Canadian and American homes during the War. Recommendations for grants from the Fund will be made from time to time by the Senate of the University of Toronto to members of the University "who wish to go to Great Britain for the purpose of study, research, or any general educational purpose, taking education in the widest possible sense." Each applicant for a grant from this Fund must submit his application to the University Registrar not later than March 1st together with an outline of the study or research which he proposes to undertake in Great Britain, or the general educational purpose which he has in mind in going there.

WALLBERG RESEARCH FELLOWSHIPS

Three Wallberg Research Fellowships, each of the value of $2,500, are open to graduates of any recognized university who propose to pursue advanced study and research in any branch of Engineering in the University of Toronto.

Forms of application may be obtained from the Secretary of the School of Graduate Studies. These should be returned together with a transcript of academic record and an outline of the proposed study and research not later than March 1st.

THE CHARLES G. WILLIAMS FELLOWSHIP IN URANIUM METALLURGY

Eldorado Mining and Refining Limited offers a postgraduate scholarship in Uranium Metallurgy to a graduate in the physical sciences, pure and applied of a value of $1,500 for an academic year and the holder is also eligible for a supplementary amount of $800 for the summer months. A cash grant to the University accompanies the fellowship.

Application forms may be obtained from the Registrar of the University and submitted to the Secretary, Eldorado Mining and Refining Limited, P.O. Box 379, Ottawa, Ontario, before 15th March.

SECTION XI. DISCIPLINE

A SUMMARY OF THE REGULATIONS OF THE CAPUT CONCERNING STUDENT DISCIPLINE

1. Subject to the general regulations of the Caput of the University regarding jurisdiction in matters of discipline the Council of University College, the governing bodies of the Federated Universities and Affiliated Colleges, and the Councils of the Faculties, Schools, and Institutes have disciplinary jurisdiction over the conduct of all students registered in these Divisions of the University in all matters of local or internal concern to these Divisions. Jurisdiction over the conduct of students while in residence regardless of the Division of the University in which they are registered is vested in the body administering the residence.

2. Jurisdiction concerning conduct likely to affect the interests of the University as a whole is vested in the Caput.

3. The Students' Administrative Council will be supported in the proper performance of all its obligations and duties as provided in its Constitution.

4. Where the appropriate body exercising disciplinary jurisdiction has found that a student of the University has engaged in conduct prejudicial to the interests of the University, the Caput may, in its discretion, suspend or expel such student from the academic privileges of the University. Every decision of the Caput involving the expulsion of a student from the University requires confirmation of the Board of Governors.

5. Any student who interferes with the personal liberty of another or who subjects another student to indignity or personal violence may be considered by the Caput or any other body exercising disciplinary jurisdiction in the University to have committed a breach of discipline.

6. Initiation ceremonies involving physical violence, personal indignity, interference with personal liberty, or destruction of property, may be deemed a breach of discipline by the Caput or any other body exercising disciplinary jurisdiction in the University.

7. Without limiting the disciplinary powers vested in the respective bodies exercising disciplinary jurisdiction as set forth in sections 1–7, the following are cited as illustrations of conduct which, in the past, has been considered a breach of discipline prejudicial to the interests of the University:

(i) The organising of a parade on the streets of the city or the taking part in such a parade without permission of the authorities.
(ii) The destruction or defacing of University property, raids on Residences or other University buildings, and the breaking into University buildings.

(iii) Rowdy and other forms of behaviour, either on or off the Campus, of such an objectionable nature as to bring the University into public disrepute.

8. Student Clubs and Associations

(a) The constitution of every society or association of students in the University and all amendments to such constitutions require to be approved by the relevant University authorities. The giving of approval, and the responsibility for the programmes of student societies and associations, shall rest as follows:

(i) With the authorities of the College, Faculty or School concerned where the membership of the student society or association is drawn from a single College, Faculty or School.

(ii) With the Board of Stewards of Hart House, where the student society or association is a Committee of Hart House and is controlled by the Board of Stewards of Hart House.

(iii) With the Caput, in the case of all other student societies and associations.

(b) No approval will be given by any of the authorities listed in (a) above to the constitution of any society or association of students if that constitution permits:

(i) Membership in the society or association to persons who are not students of the University, unless in the case of the societies listed in (a) (ii) above, where membership is open also to graduates of the University and members of the Faculty of the University.

(ii) Any action of discrimination based upon race, religion, or colour.

9. The name of the University is not to be used in connection with a publication of any kind without permission of the Caput.

SUMMARY OF STUDENTS IN ATTENDANCE

Session 1963–64

Courses		1	2	3	4	5	6	7	8	9	Total
Year	I	84	8	74	37	109	125	100	8	10	555
	II	52	5	53	29	52	69	78	17	7	362
	III	54	6	29	20	48	43	55	11	5	271
	IV	41	5	55	21	56	45	58	5	3	289
TOTAL		231	24	211	107	265	282	291	41	25	1477
Special Students											11
Diploma Course in Operations Research											9
											1497

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